

Radio Control

47380

CHEAP TRICKS
from the R/C Doctor—p. 38

CAR ACTION

THE WORLD'S LEADING R/C CAR MAGAZINE

May 1995

SPECIAL! Electronics
BUYERS' GUIDE

HOW-TO
Easy
Battery
Building

29
ESCs
compared

PLUS
speed
control
basics,
selection
hints &
mounting
tips

annual

TOP 10

I S S U E



TESTED
TAMIYA
Jeep Wrangler

COBRA
Nemesis
Sprint Car

TRAXXAS Rustler

NOVAK
Racer
ESC

USA \$4.50 CANADA \$5.50



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Return of the After-Market

As the demand for less expensive car kits grows, we must ask ourselves where the after-market accessory industry will fit into the future of the R/C car hobby. In the late '80s, kit manufacturers could barely keep up with consumer demand; and from this staggering boom of sales arose a flourishing after-market industry—one that rivaled (and in some instances exceeded) the business generated by the kit companies themselves. In many ways, the success of the after-market was short-lived, as kit manufacturers diverted more and more resources toward high-tech production techniques and extensive research and development. The quality and design of the leading car and truck kits were such that many after-market accessories became less of a necessity; in fact, a portion of the

accessory market fell back to the kit manufacturers, who offered hop-ups and updates for their own kits. By the early '90s, a number of after-market companies had closed their doors. Of those that remained, a few experienced growth, while others were forced to scale back their operations.

Now we see growth in the segment that has been dubbed "parking-lot racing." Kit sales for these low-cost, fun-type cars are on the upswing, and racing programs aimed at beginners are sprouting throughout the country. We've also seen a resurgence in the after-market industry as a result. This is good news for the stability of the

hobby industry, but some wonder whether an increase in the availability of expensive add-ons and hop-ups will tarnish the appeal of these "cost-controlled" racing cars.

A clear line must be drawn between true entry-level kits and those that have been extensively modified. By definition, parking-lot—or entry-level—racing means that you don't have to spend a lot of money to compete. We must ensure that potential parking-lot racers receive this message when they open a magazine or enter a hobby shop.

After-market parts and accessories have been, and will always be, vital parts of the hobby. Accessories such as bearings or bumpers enhance reliability and should be welcome in any organization's spec-class program. But, although they do add durability, items like after-market chassis and suspension components significantly elevate cost and create notable performance advantages over their stock counterparts. For this reason, a separation of classes, at any level of competition, and perhaps even separate terminology, may be called for. For example, an out-of-the-box car could be called "spec-class parking lot," and a tricked-out version of the same kit could be called "modified-class parking lot" or even "modified street." This differentiation may seem unimportant, but it might prevent a potential newcomer from thinking that he must spend \$300 to get into parking-lot racing, when \$150 or less is all that's needed.

John Howell

We want to hear from you! Write, fax, or e-mail us over the Internet: Car Action, Air Age Publishing, 251 Danbury Rd., Wilton, CT 06897; fax: (203) 762-9803; e-mail: Chris Chianelli—chriscc@airage.com; John Howell (Doog)—johnh@airage.com; John Huber—jhuber@airage.com; Frank Masi—frankm@airage.com.



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SUBSCRIPTION PRICES: U.S. & Possessions (including APO & FPO): 1 year (12 issues), \$29.95; 2 years (24 issues), \$54.95. Canada: 1 year, \$45.95; 2 years, \$86.62 (includes G.S.T.). Elsewhere: 1 year, \$42.95; 2 years, \$80.95. Payment in U.S. funds. Single-copy prices: \$4.50 (USA); \$5.50 (Canada). Canadian G.S.T. number R130754872.

RADIO CONTROL CAR ACTION (ISSN 0886-1609, USPS 001-087) is published monthly by Air Age, Inc., 251 Danbury Rd., Wilton, CT 06897, USA. Connecticut Editorial and Business Office, 251 Danbury Rd., Wilton, CT 06897. Phone: 203-834-2900, FAX: 203-762-9803. Michael F. Doyle, Chief Executive Officer; Y.P. Johnson, President; G.E. DeFrancesco, Vice President; L.V. DeFrancesco, Secretary; Yvonne M. DeFrancesco, Treasurer. Second Class Postage Permit paid at Wilton, Connecticut, and additional Mailing Offices. Copyright 1995 by Air Age, Inc. All rights reserved.

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ADVERTISING: Advertising rates available on request. Please send advertising materials, insertion orders, etc., to *Radio Control Car Action*, Advertising Dept., Air Age, Inc., 251 Danbury Rd., Wilton, CT 06897. Phone: 203-834-2900, FAX: 203-762-9803.

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ELITE SPEED PRODUCTS



LETTERS

STARTING OUT

I think your magazine is great! It gives good information about the selection of R/C cars available and where to get them. I have one question: is a Losi Junior Two a good car for an 11-year-old beginner?

ERIC NAMOWICZ
Spotswood, NJ

Sure thing, Eric! Team Losi produces excellent equipment, and the Junior Two is a really good entry-level car. It can be upgraded with some high-performance parts from the factory, and there's a ton of other after-market parts as well, if you ever decide to hop it up.

—Doogie

HUH...HUH... HE SAID "ROD"

Great magazine! I have an ancient Thunder Tiger Challenger 83 with an OPS 3.5cc glow engine. The connecting rod is broken. Do you have an address for OPS or Thunder Tiger? I'd like to get it fixed. Thanks for your time.

JOEL CARLSON
Raymond, MT

Well, Joel, try these two places: Thunder Tiger, 2430 Lacy Ln. #120, Carrollton, TX 75006; (214) 243-8238; and RPM Inc., 5070 Golden Dr., San Jose, CA 95129; (408) 257-7059; they make great after-market rods. I hope at least one of these places will get you on the right track. Good luck.

—Doogie

WHO SAYS WE WORK?

I admire your work and the effort that you put into your magazine. I

really enjoy it. How long does it take to print an issue, and how many people work on it? Thanks for your time.

JOSH ROBERTS
Springville, NY

Well, Josh, I must admit that your question is an interesting one. I'll give you a quick run-down and spare you the blow-by-blow commentary on how we produce the magazine. First, we work many months in advance because of our production cycle; for example, I am writing this on January 18. We usually have a couple of weeks between deadlines to work on the mag. Typically, we'll meet our editorial deadline and immediately start preparing for the next one. Here's what usually goes on....

- The editors (me, John Huber, Chris Chianelli and Frank Masi) get together and discuss what we should put into an issue, and when that has been finalized, it's entered on what we call our "issue list". We then assign any out-of-house articles to our contributors. Generally, they have anywhere from two to four weeks to prepare the story. If they're really good at their job, we might bomb them with an assignment with only a week or two to do it.

- John and I then start to write our assignments. When we've finished them, Stacey Granelli, our editorial assistant, checks through them and sends them (we're talking computer files, here) to Lynne Sewell, Air Age's copy director. In Lynne's department, the copyeditors correct any mistakes, delete the boring repetitious stuff and question any ambiguities (only the best is good enough for our readers, etc.).

- John and I start to take photographs as early as we can. We take the action shots, and our staff photographer, Walter Sidas, shoots all the studio images you see.
- After copyediting, the articles are sent electronically to R/C Car Action's art director, Betty Nero, who, with the other artists, has by then, scanned in the pics we've given her and is ready to mesh them with the type and come up with the awesome layouts you all enjoy so much.

- The layouts are passed around

WRITE TO US! We welcome your photos, drawings, comments and suggestions. Letters should be addressed to "Letters," Radio Control Car Action, 251 Danbury Rd., Wilton, CT 06897-3035. Letters may be edited for clarity and brevity, and each must include a full name and address or telephone number so that the identity of the sender can be verified. We regret that, owing to the tremendous numbers of letters and e-mails we receive, we can't respond to every one.

INTERNET ADDRESSES:

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Chris Chianelli: chrisc@airage.com.
John Huber: jhuber@airage.com.

DAHM'S

RACING BODIES



LETTERS



NEW! D022 TORNADO™ Racing Body for Narrow Width Cars like the RC10LSS. Excellent Handling Body! Recessed Bed, Spoiler & Grill Decal!
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NEW! D016 TORNADO II™ Racing Truck Body for Narrow Super Speedway Cars. Super Aerodynamics! Flat Bed, 2" Spoiler, & Grill Decal! Also fits Tamiya Toyota Prerunner, Chevy S-10, Clodbuster, USA-1, Hemi Vette & Coupe!



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(we call them "galleys" by then); editors check and approve them; then copyeditors give them a final once-over and make any necessary changes.

• By this point, Sharon Warner (advertising manager) and her team have sold the ads that will appear in the issue, and that's where production manager, Mary Reid McElwee, and production assistant, Arlene Melko, come in. The entire issue is mapped out, page by page, and then sent to the printer. We photocopy every page so that we can check everything again, because there's always a chance that we missed something.

• We get one more chance to correct errors (and errors are frowned on!) when the "bluelines"—a complete magazine printed only in blue!—come back from the printer.

Sounds like a fairly smooth process, doesn't it? You'd never guess how totally frantic our schedule is. We're always busy! But when we see the finished monthly product—and hear how much you like it—we know our efforts are worthwhile.

We're always looking for "authors," so if you're interested in shooting photos and/or writing articles, drop me a line here at the magazine (R/C Car Action, 251 Danbury Rd., Wilton, CT 06897; or Internet: johnh@airage.com).

—Doogie

POISED TO PURCHASE!

I love your magazine. I love all the articles and pictures. I also love all the stuff that's out there to buy. I think I am going to buy something soon. Thank you very much for the great magazine. Bye!

AARON MCBETH

Modesto, CA

Aaron, if you're in the mood to buy something, I'm selling my Acura. I'm sure you'll love it, too. Give me a call at the magazine, and we'll set something up. All kidding aside, thanks for the compliments.

—Doogie

HOPPIN' UP THE USA-1

Your mag is great. It has really helped me answer many questions. I've recently seen advertisements for the Kyosho USA-1, but I haven't

seen any hop-ups for it. I'm thinking of getting one, but I want to modify it extensively. Can the parts for the Tamiya Clod Buster be used for the USA-1? If not, who makes parts for the USA-1?

DAVID SANCHEZ
San Jose, Costa Rica,
Central America

Well, David, there are some hop-ups for the USA-1 out there. To get a feeling for what's available, contact Dave Sproul at Great Planes Model Distributors in Illinois: (217) 398-3630. They might have a few hop-ups available; and you might want to ask Thorp Mfg. about their diff kits: (909) 622 6518; fax (909) 622-2947. There's also a rumor going around that ESP Hobby Mfg. is working on an aluminum chassis for the USA-1; why not call them?: (815) 455-5440. We will keep everyone informed.

—Doogie

GOTTA GET GAS!

The article by George Gonzalez, "Racing Season at a Glance" (January '95), provided a phone number for Tom Grogg that seems to be incorrect. Do you have Mr. Grogg's correct phone number for the 1/8-Scale Off-Road Regionals and U.S. Open shown on page 150. Also, will you be providing updates on the events for which you didn't give dates and places?

I really enjoy your magazine and just subscribed for two full years! I currently play in off-road 1/10 scale with my O.S. CZ-Z-powered Traxxas Nitro Hawk and in 1/8-scale with my Picco PSLs-powered Mugen Athlete. There's a real shortage of R/C players in southeast Texas; if I had only one wish it would be for more tracks and more players. Your article on building your own track was great, and I'm working toward that end.

LARRY CAIN
Nederland, TX

Tom works at Great Planes Model Distributors—(217) 398-3630. We'll try to keep everyone up to speed on which events are coming up and where they'll be held. Good luck with your track; hope you have a blast on it!

—Doogie

SAND STORM

Michael Rommel of Prince George, B.C., Canada, set up his RC10 Team Car for sand drags. He used a Schumacher chassis cover for the body and equipped the car with a Novak ESC, a 7-cell battery pack and a B&R 13-turn double. He also uses a 10-cell battery, which makes it really hard to keep the front end down.



RAGIN' RACER

Gary Henderson from Tulsa, OK, says he has been out of racing for almost six years now, but he plans to fire up again with this modified RC10 Sprint car. Gary modified his RC10 with a graphite chassis and graphite shock towers, a Stealth tranny, full bearings, Custom Works Sprint Conversion with HPI custom wheels and Pro-Line Road Hawg tires. He uses a Futaba Magnum Sport radio and a Novak speed control. It looks great, Gary. Welcome back to racing!

R/C ON THE HALF SHELL

The Turtles bravely battle one of Shredder's henchmen on top of Larry Zimmerman's Ninja Turtle R/C mobile. It's based on a shortened 1/10-scale frame and is powered by a Tamiya 380 motor (sorry...no Turtle power!). Larry designed this Turtle van for display at his local club, and it has run in the annual city parade in Regina, Saskatchewan, Canada. So that's where those Turtles have gone.



"Readers' Rides" is our way of recognizing the unique, innovative—and sometimes bizarre!—vehicles that our readers have created. Send us a sharp, uncluttered, well-exposed color photo of your car or truck (no Polaroids, please!), along with a brief description, to Readers' Rides, R/C Car Action, 251 Danbury Rd., Wilton, CT 06897. If the Ayatollah of Radio Controlla chooses your photo, you'll receive a 6-month subscription to Car Action, or an extension of your existing subscription. You'll also be eligible for the fourth annual "Readers' Rides of the Year Contest" in the fall of 1995. Write your address and phone number on your letter and on the back of each photo you send, in case we need to contact you.



SMOKIN' STREET ROD

Hans-Werner Oha of Germany sent us this photo of his home-built '32 Ford. Hans designed and built the aluminum chassis, the front axle and the ball diff. The brass, 5-spoke wheels have polished-aluminum rims and are fixed on the axles with five bolts. The car features Kyosho rear tires and Tamiya front tires and rear shocks. He uses a Futaba radio system and a Hitec ESC. Good work, Hans!



RAD RIDE

Carlos Carvajal of Guadalajara Jalisco, Mexico, sends us this photo of his massively modified Lynx II Elite. This hot ride features: Associated front suspension; an HPI wide, front brace; a Lunsford titanium front end; Bud's progressive blue springs; RPM ball ends; TRC purple-anodized pro shocks; a TRC damping plate; Tecnacraft on-road wheels; and much more! Carlos uses a Tekin 411 G2 ESC to control the Reedy Sonic C motor, and Trinity Ex-World Tech 27A batteries provide the power.



STINGING SPEED

This "slightly" modified Kyosho Stinger Mk II comes from Claus Raddatz, an engineer currently working in Germany. He says that the car started out stock but didn't stay that way for long. Claus added Kyosho Gold shocks with Trinity silicone oil, full ball bearings, a one-way differential, an A&L steering bellcrank system, a Paris tuned pipe, a custom-made radio plate and chassis stiffener, HPI 5-spoke wheels and Pro-Line tires. He feels that the most significant modification is the engine. By machining his own chassis and modifying the drive train and transmission, Claus was able to stuff an O.S. RXB .21 into the car. He says that, with 2.1hp and all-wheel drive, the performance is mind-boggling!



SNAP, CRACKLE, POP

Andy Haw from Manistee, MI, asks, "What do you hear when a Junior Two turned LX-T that's racing a full-size Ford Explorer has a 20-foot lead and spins out?" The answer—crunch! The milled-out chassis snapped, and the Trinity chrome rims, LX-T rear arms, chassis brace and front bulkhead all had similar fates. Andy tells us that, amazingly, the electronics survived. He says that this experience has taught him to avoid driving in the road, but he still can't resist chasing drivers'-ed. cars.

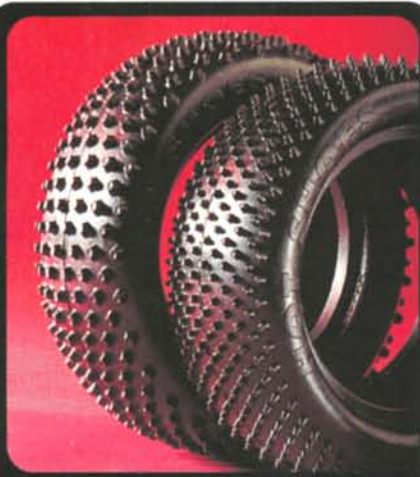
BLUE THUNDER

This 1/10-scale Worlds sports car was sent in by Tom Kendall of Lakewood, CA. It's equipped with a Bolink Eliminator Gold chassis, Tecnacraft BBS rims, an HPI 16-turn double motor, a Tekin 411 ESC and Futaba PCM radio gear. The body is by Dahm's, and the driver comes from a Blackfoot kit. Tom says he races in sportsman modified and has received first-place concours at an Ultimate Hobbies Road Course Parking Lot race. Congratulations, Tom!



In search of fun
and glory, cause
life's too short
to be a sheep • by Chris Chianelli

INSIDE scoop



Pac-Off TAC-Man

According to Hot Shoes of Canada, their new off-road TAC soft and tacky rubber compound is formulated to outperform all the other compounds on the market. Hot Shoes further points out that they had pairs of their competitors' tires sent to laboratories for chemical analysis so that they'd be able to improve on them and come up with their TAC Flat-Top Micro-Pin and TAC Mini-Pin Stub tires. We'll see how they do on the racing circuit. Both are available for 2.150-, 2.175- and 2.20-inch rims. For more information, contact Hot Shoes, P.O. Box 1277, Mississauga, B Station, Ontario, Canada L4W 2G4; fax (905) 569-1528.

STREET LEGAL

Here's a look at Trinity's R/C Street Pack—the official Street Spec-approved, sealed, 6-cell pack. This latest addition to the EX-Spec line of batteries uses the new EX-Spec 1400mAh cell developed jointly by Sanyo and Trinity to bring R/C racers an inexpensive, dependable cell specifically for stock-class racing motors. According to Trinity, this cell retains its stability through repeated discharge cycles, so it's perfect for "Spec" and stock-class racing. You'll find it available in 6-cell (\$21.99) and 4-cell (\$15.99) packs; and it's from Trinity Products Inc., 1901 E. Linden Ave. #8, Linden, NJ 07036; (908) 862-1705; fax (908) 862-6875.



12 Tigers

During the past decade, Thunder Tiger has invested tremendous resources—effort and cash—to bring forth what I think are some of today's finest glow engines—and at very affordable prices. That's my opinion. To produce them, Thunder Tiger not only procured top engine designers with many years of experience, but they also used the latest

CAD/CAM design and CNC machining equipment. The Pro .12 Series engines are powerful, precision-made gems. I know this sounds like an advertisement, but it happens to be true.

Pictured are the latest ball-bearing Pro .12 BB ABC heat-sink engine and its pull-start counterpart. Both versions can be bought with a shaft that has been pre-cut for the RC10GT. The Pro .12 Series engines can be mounted where an O.S. or a Dynamite was once mounted—no drilling or filling is necessary. Be sure to check them out. Contact Thunder Tiger USA, 2430 Lacy Lane, #120, Carrollton, TX 75006; (214) 234-8238; fax (214) 234-8255.

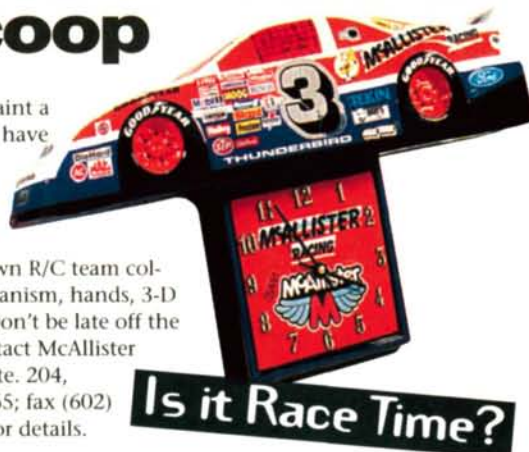
All 3 from Parma/PSE

It's called the "Supertruck Series," and it's rumored that Parma/PSE is the first to have all three race truck bodies—Dodge, Chevy and Ford—ready for the road and track. This past winter, Chuck Mann of NORRCA piloted a PSE Dodge Ram oval truck body around the California Dominguez Hills Velodrome at an average speed of 60.7mph! And you thought pickup trucks weren't fast! All three fit narrow, speedway, pan-type chassis and Tamiya 2WD chassis. They list for \$19.95. Contact Parma Intl., 13927 Progress Pkwy., North Royalton, OH 44133; (216) 237-8650; fax (216) 237-6333.



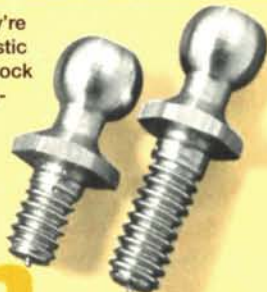
INSIDE scoop

If you already know how to paint a polycarbonate body, you can have one of these 1/10-scale Chevy Monte Carlo or Ford Thunderbird clocks in your shop or den. Paint it to look like your favorite driver's car, or use your own R/C team colors. The kit includes a clock mechanism, hands, 3-D numbers and masking material. Don't be late off the line! Keep track of that time! Contact McAllister Racing, 1000 N. Humphreys St., Ste. 204, Flagstaff, AZ 86001; (602) 556-0665; fax (602) 556-0725. Ask your hobby shop for details.



Is it Race Time?

Coming this spring!—MIP's new B.J. Ball Ends. They're oversize—just enough to ensure a snug fit into plastic ball cups. They eliminate the play so often found with stock linkage hardware. B.J. Ball Ends are made to have a diamond-like finish using high-grade stainless steel, so they resist rust. Prices aren't available at this time, but I'm told they'll be competitive. For more info, contact Moore's Ideal Products, 746 Edna Pl., Covina, CA 91723; (818) 339-9008; fax (818) 966-2901.



Maximum
OVERSIZE

PORT-A-POWER



Ever run down your car battery doing the trackside charging thing? No? Well, I'm not proud; I admit it: I have. But I could have used the Power Pak from Rusty's Racing Products. With its self-contained 12V battery, it's not only very convenient for trackside use, but it can also be charged from either a 110V AC wall current or parallel-charged at 12 volts DC directly from your car (with the included lighter plug). Power Pak has a convenient handle, molded arms for excess charger wire and a strap to hold the Ni-Cd charger in place for convenient charging in the pits. Also included is 12V meter and test button to give you an accurate voltage reading at any time. Its list price is \$169. For more information, contact Rusty's Racing Products, 10550 Noland Rd., Overland Park, KS 66215; (800) 473-1109.

ZIP PAK™

Professional Power for Pennies...

It has been said the human hand is better than a computer at assembling battery packs. Don't believe it! Computers don't have bad days. They don't break up with their girlfriends and they don't have headaches. People do. That's why they don't always do the same job the same way twice. They're only human.

That's why Trinity uses an exclusive, computer-controlled, automated assembly system for their Zip Pak. Reliability and consistency are programmed in and never vary.

This automation is combined with the very finest materials. The cells are Sanyo KR1300SC (1300mAh) and there has never been a world champion that didn't run Sanyos. They've never lost! All tabs are pure nickel and as short as possible to minimize resistance. Each is double welded, and all wires are pure copper with silicon insulation. The entire assembly is pressed into a precision fitted tube which protects it from the rough and tumble world of racing.

As the bare, assembled pack nears completion, it is connected to an instrumented quality control panel which measures all facets of the pack's performance. Only then is the Zip Pak label applied.

The result is the lowest cost, highest quality sport pack available.

Buy several as back-up spares. Never be short of power.



TRINITY

Trinity Products Inc

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CORALLY Close By

Many of you already know Corally's line of very fine on-road cars, hardware and accessories from Holland. I'm happy to announce that these products will soon be coming to the U.S. via Du-Mor R/C Inc.; they promise reliable parts availability and excellent customer service. This new, ready-to-use, Tire Sizing Machine is just one example of the precision equipment that Corally has supplied to the European market for years. It comes with adapters to fit all $\frac{1}{10}$ - and $\frac{1}{12}$ -scale American-style wheels as well as those made by Corally. You should also look for Corally's $\frac{1}{10}$ -scale F1 car!

For more info, contact Du-Mor R/C Inc., 1002 Union Landing Rd., Cinnaminson, NJ 08077; (609) 829-1338; fax (609) 829-9303.



2 Dahm Bad Bodies



So you and your buddies want to go out and do some F1-style parking-lot racing, but you don't want to be forced into buying new cars. Now you can. Use Dahm's new F1 Fighter™ body to convert almost any $\frac{1}{10}$ -scale pan chassis (such as Associated's RC10L and RC10LSS) into an F1 car. To fit $\frac{1}{10}$ -scale pan chassis, the Fighter body is larger than the true $\frac{1}{10}$ -scale Tamiya and Kyosho F1 cars. It's actually much closer to $\frac{1}{8}$ scale. Check out the Fighter's super-low aerodynamic style, its bi-level front wing and bi-level Adjustable Fighter™ rear wing, the great motor-cooling-scoop driver figure and Dahm's decals. (The Adjustable Fighter wing is also available separately for use with other bodies.)

Also new from Dahm's is this $\frac{1}{10}$ -scale BMW M3 Extreme body, which was designed specifically for Tamiya's sedan chassis. Contact Dahm's Racing Bodies, P.O. Box 360, Cotati, CA 94931; (707) 792-1316; fax (707) 792-0137.



Kinwald Delivers Power And Precision.

Team Kinwald brings you new ways to go fast. The BuggyWald™ off-road modified motor delivers heavyweight performance on a lightweight budget. And, Kinwald "Hard Ones"™ hardened steel pinions turn out precision and long life like no other.

"If my first Modified Motors had been this fast, I'd been World Champion a lot sooner."

— Brian Kinwald
Current IFMAR World Champion



Epic "EZ Flow"™
Endbell and
Can

High Performance
Brushes and
Springs

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Double
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Wound
"Short
Stack"
Armature

Easily
Adjustable
Timing

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Precision
Ball Bearings

TK2018 Only \$46.99



The "Hard Ones"

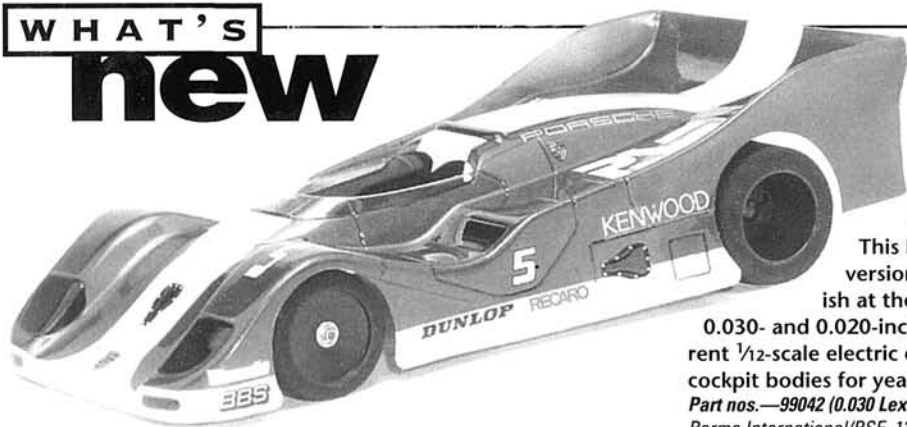
Team Kinwald brings you the new "Hard Ones" off-road steel pinions. With a Zero Gravity™ design, each pinion is case hardened to a 58-62 Rockwell C hardness to a consistent depth of .0010". Only total destruction would cause tooth deformity. Last, a black oxide coating is applied to prevent rust prior to use. Kinwald "Hard Ones" are the longest lasting pinions available. In 48 pitch only, 12 - 27 tooth sizes. Only \$4.99.



TEAM KINWALD BY
TRINITY®

1901 E. Linden Avenue, #8, Linden, NJ 07036 ■ 908.862.1705 ■ Fax 908.862.6875

WHAT'S new



PARMA INTERNATIONAL K-8 Kremer Porsche 1/12- Scale Body

This body has been molded after the full-scale version that Derek Bell piloted to a sixth-place finish at the '94 24 Hours of Le Mans. Available in clear

0.030- and 0.020-inch-thick Lexan, the Porsche K-8 fits most current 1/12-scale electric on-road cars. It will set a precedent in open-cockpit bodies for years to come.

Part nos.—99042 (0.030 Lexan), 99042L (0.020 Lexan); **price**—\$11 each.

Parma International/PSE, 13927 Progress Pkwy., North Royalton, OH 44133; (216) 237-8650; fax (216) 237-6333.



ASSOCIATED ELECTRICS Replaceable-Tip Allen Drivers

Associated is happy to announce that these drivers are back in stock and are available in six sizes. In addition, they've improved the handle's finish and the quality of the tips.

Replacement tips are available for all six sizes for \$5.50 each.

Part nos.—6957 (0.050-inch), 6958 (1/16-inch), 6959 (5/64-inch), 6960 (3/32-inch), 6961 (2.5mm), 6962 (1.5mm); **\$10.50 each.**

Associated Electrics Inc., 3585 Cadillac Ave., Costa Mesa, CA 92626; (714) 850-9342; fax (714) 850-1744.

DU-BRO PRODUCTS Kwik-Start XL

This XL version of the Kwik-Start is designed to reach those hard-to-reach glow plugs in gas cars. Like the Kwik-Start, the Kwik-Start XL comes with a Sanyo sub-C Ni-Cd battery (1300 to 1450mAh), a charger and a free Kwik-Mount Storage Klip.

Part no.—666; **price**—\$16.95.

Du-Bro Products Inc., 480 Bonner Rd., P.O. Box 815, Wauconda, IL 60084; (800) 848-9411.



DAVIS DIESEL

Air Filter Clamp

Are you looking for a better way to hold your air filter on your carb in .12 and .15 engines? Davis Diesel has just introduced a clamp that's just like those used on full-size cars, only this one is much smaller and lighter. On small engines, one clamp fits perfectly around the carb; on larger, .21 engines, use

two. Two also work well for coupler connections.

These clamps are so strong that you'll rip the carb off the engine before you'll pull the filter off the carb.



Part no.—McClamp; **price**—\$1.95.

Davis Diesel Development, P.O. Box 141, 132 Pepes Farm Rd., Milford, CT 06460; (203) 877-1670.



PRO-LINE XTR Dirt Hawgs II

These serious 2.2-inch off-road treads are made to take on any rugged terrain—dirt, grass, desert, or parking lot. They feature a high-profile rugged design for exceptional traction and performance. The Dirt Hawg II will convert any stadium or monster truck into a mean, all-terrain machine.

Part no.—1070; **price**—\$17.95.

Pro-Line, P.O. Box 456, Beaumont, CA 92223; (909) 849-9781; fax (909) 849-2968.

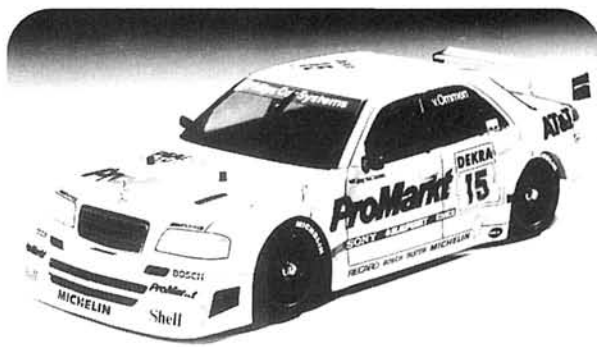
TAMIYA

ProMarkt Zakspeed AMG Mercedes

This 1/10-scale Zakspeed version of the AMG Mercedes features the race-proven TA02 4WD chassis; long front-suspension arms; independent double-wishbone suspension; four, large-capacity, coil-over, oil-filled shocks; a scale-accurate, polycarbonate Mercedes body; and much more! With realistic looks and performance to match, the Zakspeed AMG Mercedes is taking on-road racing by storm.

Part no.—58145; **price**—\$169.95.

Tamiya America Inc., 2 Orion, Aliso Viejo, CA 92656-4200; (800) TAMIYA-A; fax (714) 362-2250.





SCHUMACHER Front and Rear 3-Spoke Wheels

These new, front, 3-spoke wheels are 2 1/4 inches in diameter and 3/4 inches wide, and they're designed to fit the Associated RC10 and the Losi Double-X. The rear wheels, which are 2 3/8 inches in diameter and 1 3/8 inches wide, will fit the RC10 and will soon be available for the Losi Double-X. They're both dyeable, so your car will look great and go fast.

Part nos.—U1616 (front wheels); U1615 (rear wheels); **price**—\$5.95/pair.

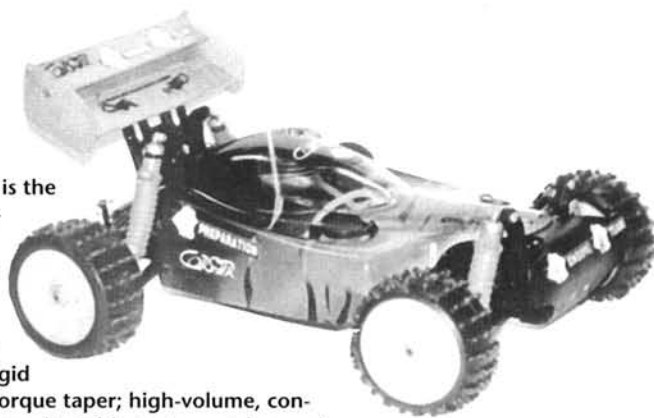
Schumacher Inc., 6302 Benjamin Rd., Ste. 404, Tampa, FL 33634; (813) 889-9691; fax (813) 889-9593.

DOWNTOWN HOBBY Micro-Racing Corsair

The Micro-Racing Corsair is the ultimate 4WD, nitro-powered, 1/8-scale, racing buggy. This off-road kit is the only one in its class that comes with a four-piece clutch shoe; all four universal drive shafts; a rigid central drive shaft; steel torque taper; high-volume, constant-level shock absorbers; adjustable caster, camber and toe-in; 18, protected, high-speed ball bearings—and more! Also available in an RTR version.

Part no.—Corsair; **price**—\$649.95.

Downtown Hobby, P.O. Box 848368, Hollywood, FL 33024; (305) 964-0701; fax (305) 964-9728.



DURATRAX Spike™ ESC

This forward-only sport ESC was designed specifically for modelers who are making their first move up from mechanical speed controls. Compatible with most 1/10-scale cars, this low-priced ESC features a neutral point adjustment, MOSFETS, temperature-sensing circuitry and battery-eliminator circuitry. It comes complete with heat sink, capacitors, a screwdriver, instructions and a 120-day warranty.

Part nos.—DTXM1005 (Futaba J), DTXM1006 (Airtronics); **price**—\$69.99.

DuraTrax/Great Planes Model Distributors, 2904 Research Rd., Champaign, IL 61826-9021; (217) 398-3630; fax (217) 398-0008.



THORP MFG. Aluminum Diff Gear for the RC10GT

This new hard-anodized aluminum diff gear replaces the stock nylon gear in the RC10GT. It's stronger than the stock gear and will last much longer.

Part no.—4782; **price**—\$5.

Thorp Mfg. Inc., 4054 E. Mission Blvd., Pomona, CA 91766; (714) 622-6518; fax (714) 622-2947.

TOWER HOBBIES

Tower Power Model 420 AC/DC Charger

This AC/DC charger uses standard household current or a 12V DC source to renew your 6- or 7-cell Ni-Cds. Set the mechanical timer, and the fuse-protected charger will automatically switch to trickle-charge when quick-charging is finished. Additional features include charge/discharge circuitry for cell cycling, an analog ammeter, a Tamiya connector, a Kyosho adapter and a one-year warranty.

Part no.—TOWP0150; **price**—\$34.99.

Tower Hobbies, P.O. Box 9078, Champaign, IL 61826-9078; (217) 398-3630; fax (217) 398-6608.



MIP

CVDs for Associated Cars and Trucks

World Championship-winning MIP CVDs™ (constant velocity drives) are the only completely rebuildable drives that have won national and IFMAR competitions. Factory team drivers use MIP CVDs™ to get into the winners' circle—and you can, too. Available for Associated's RC10, 10T and 10GT.

Part nos. and prices—CVD-10, \$27.50; CVD-10T, \$32.50.

MIP, 746 E. Edna Pl., Covina, CA 91723; (818) 339-9007.





TRUBLE SHOOTING

by John Huber

The Nitty Gritty

I hope you can help me with this small problem. I recently purchased a set of ball bearings, and I've run my car out in the dirt several times since I installed them. I just took them out the other day, and they're feeling a little bit gritty. They aren't shot, are they? Do I have to buy new ones? I'm wondering if I can clean them out, and, if so, what's the proper way to do it? I don't want to ruin them.

FRANK REMICK
Brooklawn, NJ

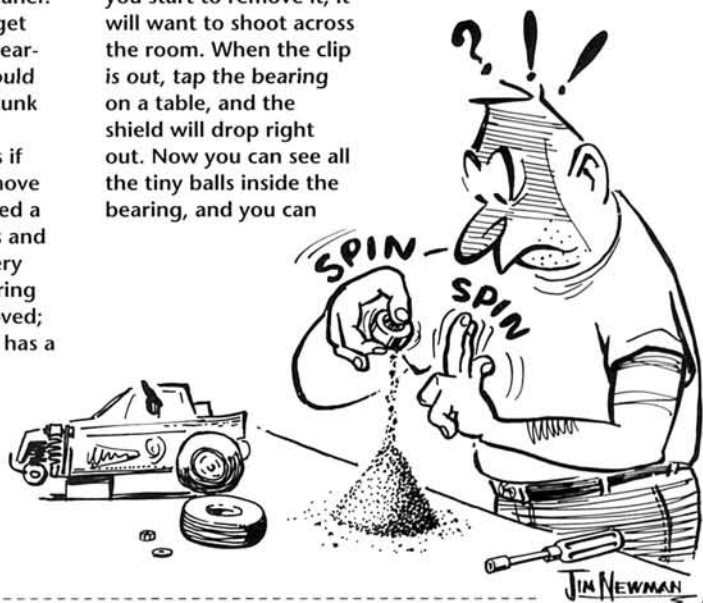
If they feel gritty, you need to take care of them before it's too late. One method that works pretty well is to just blast them with motor spray and hope that all the bad

stuff comes out. I jam the bearing on a tapered reamer, hold the bearing's outer race and give the reamer a good spin while I spray the cleaner. As long as you can get the spray into the bearing's shield, you should be able to get the gunk out.

If they still feel as if they need help, remove the shield. You'll need a good set of eyeballs and a knife that has a very fine tip. Not all bearing shields can be removed; the removable type has a tiny circular clip that fits into a groove and holds the shield in place. In one spot, there's a slight break in the clip that you can

snag with the tip of the knife and pull inward. Be careful! The tiny clip is held in place by the groove, and as soon as you start to remove it, it will want to shoot across the room. When the clip is out, tap the bearing on a table, and the shield will drop right out. Now you can see all the tiny balls inside the bearing, and you can

give them a good blast with the spray to clean them. After they've dried, add a drop of light oil and re-install the seal.



JIM NEWMAN '95



JIM NEWMAN

Droppin' Dogbones

I'm 14 years old and own a Futaba FX-10. It's a great, inexpensive, electric car. It's really durable and reliable for a beginner car. It has DuraTrax Gold competition shocks and a Trinity Slot Machine II motor. The car really flies on the road.

It's a little bouncy in the back with its original shocks, but none of the after-market shocks will work with it, because the dogbones fall out going over the slightest bump. My R/C car enthusiast friends agree that your magazine should feature

more cars with combo prices under \$160. I've been very lucky with my car, and I'd really love to see the Futaba FX-10, or a similar car, featured.

DAVID DAIVSON
Enterprise, AL

David, you can fix the dogbone problem very easily. The reason they fall out is because there's too much down-travel with the after-market units. To remedy this, add a piece of fuel tubing or hard plastic tubing on the shaft inside the shock body. This will prevent the rear arms from dropping too much. Build the new shocks, using the old ones as a guide for length. Cut two pieces of tubing of equal length, add one to each of the shocks' shafts and continue assembling them, without oil.

If it's a good length, fill 'em up and go for it. You also might want to make sure the problem isn't that the shocks are too short when they're compressed. If this is the case, you can add tubing or small O-rings to the shock shaft outside the shock body.

ILLUSTRATIONS BY JIM NEWMAN



Play Time's Over

I own a Tamiya Jaccs Civic front-wheel-drive sedan parking-lot racer. I've found that some of the suspension pivot areas, as well as the shocks, tend to be a little loose. I'd like to eliminate some of the slop: any suggestions? Also, I found that the rear end tends to slide out if I'm cornering really hard. Also, what do you recommend as hop-ups for this car?

BRETT WEIR
Kalamazoo, MI

Brett, I have some good tips for you. I was similarly disappointed with the fit of some of the parts on my front-wheel-drive car. My first solution was to ditch all the brass shock bushings. They just don't fit well, and they add slop to the suspension system. I took some Dynamite fuel line, jammed it through the top and bottom of each shock, and cut the line so a little sticks out on either side of the shock-mounting hole. Then, I pushed the stock mounting bolt back through and tightened the bolts so that the tubing is slightly compressed, but not too tight. Now there's no play in the suspension system.

I found another use for those brass shock bushings. I carefully drilled the suspension arms'

inner hinge-pin holes and pressed the bushings into the arms. They fit a little more tightly than the stock setup, yet they still allow free movement. Another way I found to reduce slop in the steering was to add shock O-rings to the ball joints. Adding the O-rings to every ball joint before I snapped on the plastic link almost completely eliminated play in the steering system.

Besides bearings, the first hop-up I'd recommend is a set of stickier after-market tires. They should solve the rear traction problem.

Masking Tricks

When spray-painting the inside of a Lexan body, you have to completely cover the outside of the body. I've tried masking tape and newspaper, but the paper tears or rips, and then I have to stop and fix it. What are the tricks of the trade for masking the outside of a Lexan body? Also, can I use graphic colored tape from an art-supply store for stripes? Thanks.

KEN HEITING
St. Petersburg, FL



Big-Tire Blues

I'm a 16-year-old R/C car enthusiast. I own an RC10 with a graphite chassis and a Hyperdrive belt system. Which parts should I order to put Clod Buster tires on my RC10? I understand that I may need to cut some of the chassis to accommodate the large wheels. I also understand that I would need longer axles and adapters for the wheels. Please let me know which companies make the products needed, or if a company makes a kit to do what I want. Last, I

would like to know what kind of gearing would be needed to turn the huge tires, and which motor would you recommend for the torque it will need?

BRIAN BLANEY
Tucson, AZ

Brian, adding all this stuff to your RC10 would be a lot of work and would cost a bundle. Let's say that you could find adapters to put the wheels and tires on the car. First, the Clod doesn't have bearings in the rims, so you would have to extensively modify a set of rims to get them to work. The Clod tires are also about 4 inches wide, so there will be a clearance problem in the front and rear. Even if you could get the tires to fit on the car, you wouldn't be able to get

much steering before they hit the chassis.

The Clod tires are about 18 inches in circumference, compared with the RC10's 10-inch tires. To gear it properly, you would have to reduce the pinion gear by about half the number of teeth or increase the spur by the same amount. You might be able to pull this off, but I doubt that the Hyperdrive system would be able to handle it. By the time you finished, you would have one goofy vehicle that was a major headache. If you really want to put bigger tires on the car, try some racing-truck tires; you won't have to modify the chassis or gear ratio much, and the rims are available. If you want bigger tires than that, get a Clod!

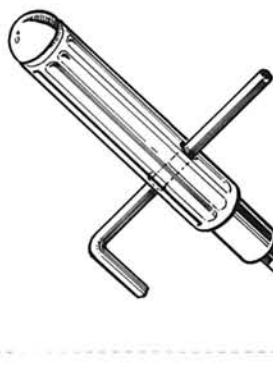
Ken, for masking, try the clear plastic bag that came with the body. Flatten it out and apply masking tape to one edge, leaving about half the tape's width overlapping. Stick that overlapped tape to the bottom edge of the body, making sure to cover the whole side. At this point, to prevent a disaster, cover any body-post holes with masking tape. Fold the rest of the plastic bag over the body and tape the opposite side with more masking tape. Then just bunch up the excess plastic and tape it around the outside of the body. It seals well, and you can see how your paint job looks. As far as the graphic tape goes, you'll have to test it out yourself. I've used graphic line tape for thin black lines on the outside of a body with success, but brands might vary. ■





PIT TIPS

by Jim Newman



DRIVER T-BAR

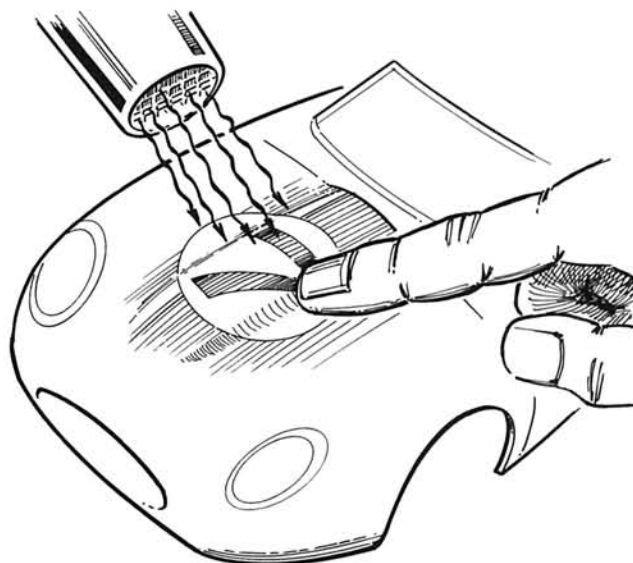
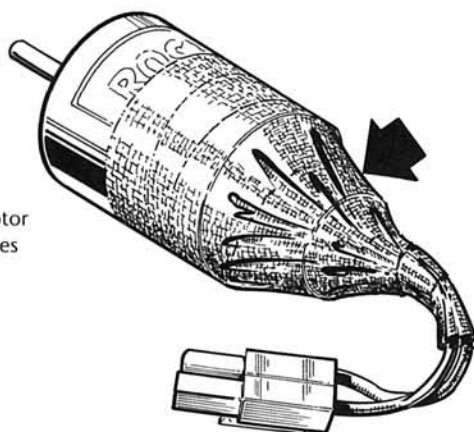
For additional leverage when your hands are sweaty, drill a small hole through the handle of your screwdriver or nut driver, and slip a wire rod or a spare Allen wrench through it.

*John DiNisio,
Clifton Park, NY*

STICKY DIRT COVER

During a messy race, keep dirt and water out of your motor with this self-sticking, elastic bandage; it can be formed nicely around the motor endbell and wires and provides significant support for the wires, too.

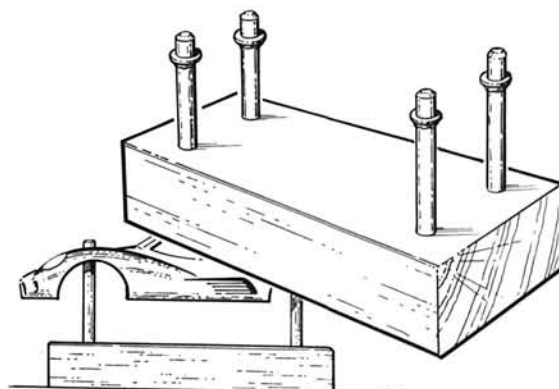
*Hector H. Santos, Bayamon,
Puerto Rico*



WRINKLE REMOVAL

After putting the decals into place, carefully heat them with a hair dryer to soften them; then burnish them down smoothly with a finger. No wrinkles; no bubbles!

Will Dorman, Meadville, PA



BODY-MAINTENANCE STAND

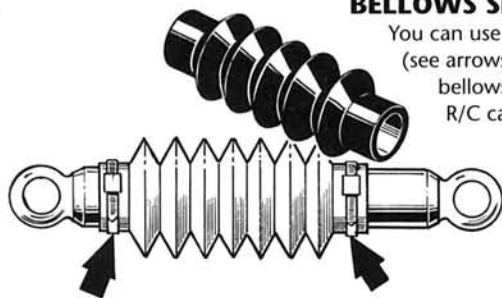
To make a sturdy stand to support your car's body when you work on it, take some spare body-mounting posts or some dowels that have washers glued to them (as shown), and insert them into a 2x4-inch (50x100mm) wooden block; make sure that the holes for the dowels or mounts are spaced to match the holes in the body.

Chris Kreidel, Huntington Beach, CA

BELLOWS SHOCK BOOTS

You can use very small cable ties (see arrows) to secure these rubber bellows dirt excluders to your R/C car's shocks; they're sold in motorcycle shops as bellows for brake and clutch cables.

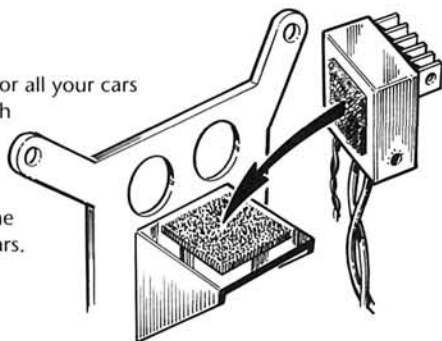
*Jerry Doherty,
Norfolk, NE*



SHARED ESC

Use only one ESC for all your cars by mounting it with Velcro®-brand-fastener. Be sure to use the matching half of the Velcro® in all the cars.

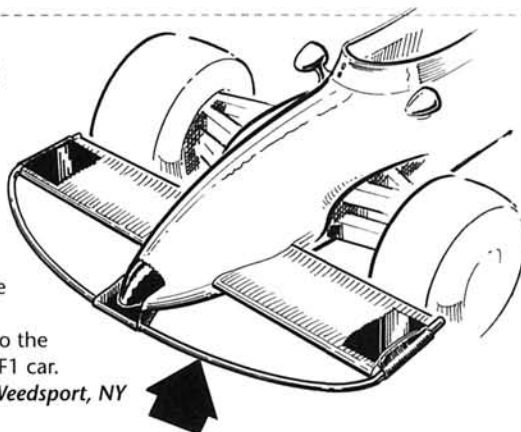
*Brad Johnson,
Balboa Island, CA*



F1 STONE GUARD

Protect your vehicle from large, body- and wing-damaging stones by taping a piece of bent coat-hanger wire to the front of your F1 car.

Brent Ryan, Weedsport, NY



ROLL YOUR OWN!

If you race with foam tires, you *need* a tire truer. MAXMOD offers several sizes to suit your budget.

Check these out!



**Bench
Racer
DC Truer
PN 10-003**

Our "Entry Level" model runs on 12 volts DC. Big performance for a small budget. Powerful enough for even 1/8 scale tires.

**Pro
Tire
Truer
PN 10-001**



20 pounds of pure muscle. Our top of the line unit. Massive torque with constant speed make short work of even the toughest tires. 120 VAC.



**Deluxe
Tire
Truer
PN 10-002**

Our most popular model. 71/2 pounds of power and accuracy. Its size makes it great for the racer who travels. 120 volts AC.

**Tire
Durometer
PN 40-001**



To really know your tires you need one of these. Accurately measures rubber hardness. Can be used on foam and cap tires.

MAXMOD tire truers include adaptors for 1/10 and 1/12 electric pan cars. Many other adaptors are available.

GET SMOKIN' with

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mini sports



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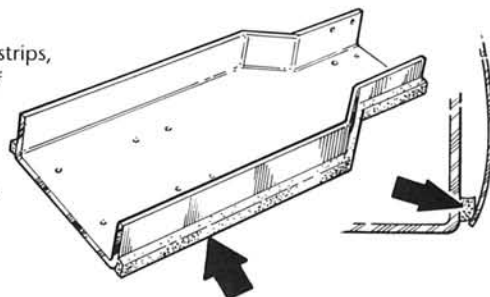


PIT TIPS

CLEAN TUBS

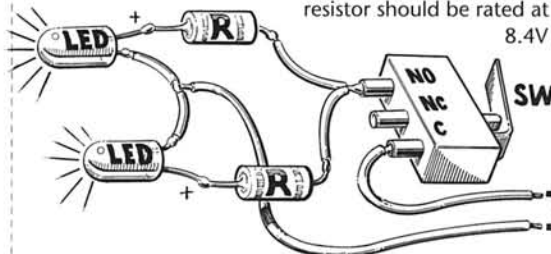
Cut a supermarket sponge into thin strips, and glue it around the lower edge of your chassis tub to prevent mud and water from getting inside your car. Check your hardware store for deals on self-adhesive, sponge-foam, draft-excluder strip, too.

James Ward, Merced, CA



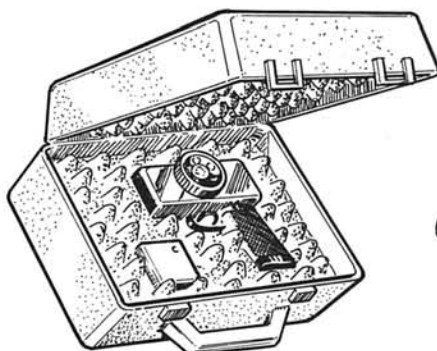
RC10 BRAKE LIGHTS

Most owners add brake lights that run off a separate battery; this system operates off your Ni-Cd pack. From Radio Shack, buy two red LEDs, two resistors (R) and a microswitch (SW), and wire them up as shown. The secret to operating off your Ni-Cds is to pick the right resistors; for a 7.2V pack (6 cells), each resistor should be rated at 240 ohms and 1/4 watt; for an



8.4V pack (7 cells), each resistor should be rated at 280 ohms and 1/4 watt. Connect the positive wire to the LED's longer (positive) lead, and cover all the joints and bare wires with shrink-tube.

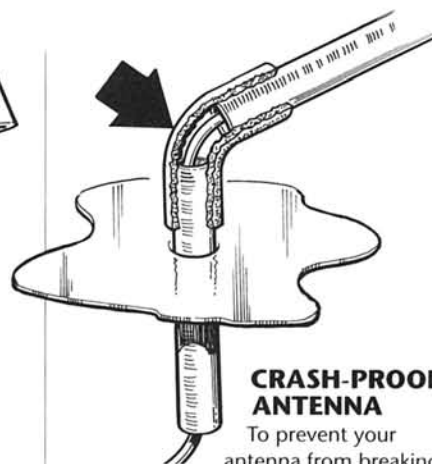
David Brodbeck, Alma, MI



HAVE CASE—WILL TRAVEL

Hard-shell pistol cases that are large enough to hold four pistols are often available at discount stores for around \$10. They contain "egg-crate" foam that can be cut to fit your transmitters, chargers, etc.

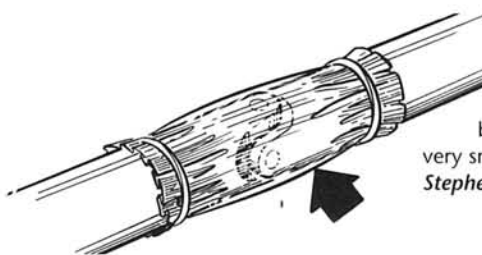
Frankie Hall, Anderson, SC



CRASH-PROOF ANTENNA

To prevent your antenna from breaking if your car rolls over, put a flexible joint at the bottom end; simply cut the antenna as shown, and join the two parts with a short section of rubber fuel line.

Josh Koplin, Gales Creek, OR



TRAXXAS U-JOINT BOOTS

Seal out dirt, and extend the life of your U-joints by cutting the neck off a balloon and securing it over the joints with very small, orthodontic rubber bands.

Stephen Malfatti, San Ramon, CA



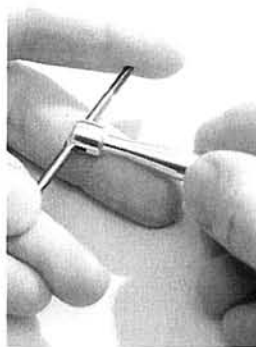
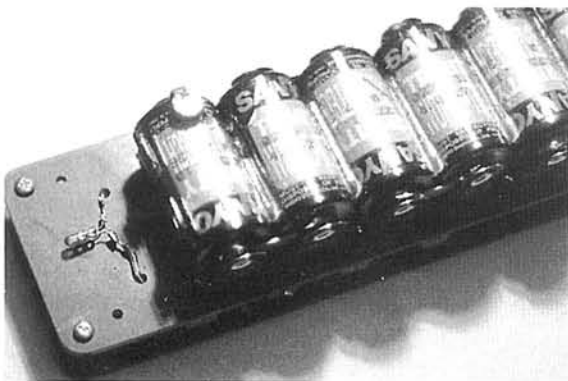
Yet more tips from the secret underground laboratory...

DISCHARGE DOOZY

When I upgraded my oval batteries this year, I got one of those high-zoot battery-discharge trays from Trinity*; it's really easy to use. Just discharge your batteries on a dozen or more bulbs until the lights are almost out, then plunk the battery pack into the discharge tray; it brings all the cells down to just under a volt. It's perfectly safe to use with any type of battery cell, and you can leave your cells on the tray practically forever without damaging them.

Because I run in both stock and modified classes,

I need to know when the cells have been fully discharged so that I can put another pack in. My problem was that, even by touching the discharge resistors, I couldn't really tell whether the pack had been fully discharged. I wired a 2.5V mag-light-type bulb from Radio Shack to the lugs of the last two cells on the tray (2.4 volts—get it?). When the pack is inserted into the discharge tray, the light is very bright; at full discharge, the light goes out. It works like a charm!



TURNBUCKLE TRIUMPH

Kelly Lunsford at Lunsford Racing* makes jewel-like turnbuckles that you have to see to believe! His stuff is available in increments of 1/8 inch, so you can always get the perfect length for any application. Even more impressive is this new turnbuckle tool he recently sent me. Machined and turned on a lathe, it's a real work of art. It grips the turnbuckle center precisely and allows you to make exact adjustments.

■ Bend at dotted line to 90°

■ Mount base to receiver or chassis with servo tape

Stealth Antenna Pattern

WONDERFUL WIRE-HOLDER

Have you ever wanted to own one of those Joeldesque, stealth-type, antenna-wire holders, but you don't know how to make one? The secret has been revealed! Cut out—or copy onto a piece of flat 0.030-inch-thick Lexan—the pattern below, and you'll be the envy of your pit buddies! The cost? Around 25 cents!

■ Drill holes at dots with 1/32" drill bit ■ Weave antenna wire through holes, moving from one side to the other

BATTERY-BOX BRAINSTORM

You may recall that, in a previous column, I said I was trying to find a good battery box. I had been hauling my batteries around in an old cardboard RC12L box for a couple of years, and it was getting pretty tattered. One day, at the grocery store, I saw an inexpensive, latch-lid pencil box that looked about the right dimensions. For \$1.99, it was worth a try; so I took it home, and the battery packs fit beautifully! To prevent the packs from hitting one another and shorting out, I cut 2x7-inch-long strips of Lexan, bent the ends about 1/2 inch, and held them in place with servo tape. The batteries fit perfectly, and I can carry seven packs at a time. I'm sure this box will last a lot longer than the cardboard one I had been using.





BEARING SHARING

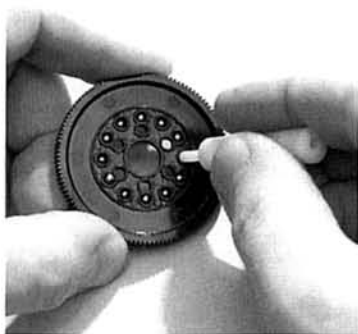
Have you ever tried to get your diff really smooth, only to be frustrated when you continued to get that "grind-o-matic" feeling when it had been fully assembled? You replace the diff balls and rings, but it still feels as though there's sand in there! Clean everything again, but no

change. Wait! Don't throw the entire car into the creek. Try moving the rear diff bearings around; sometimes, all it takes to make your diff as smooth as glass is swapping the inside and outside diff hub bearings. You can even swap the axle and diff bearings if you have to.

HANDLE WITH CARE

Speaking of diffs, what do you use to pop the dirty balls out of the spur gear? If you're like me, you don't want to throw them away until you've cleaned them and tried them again.

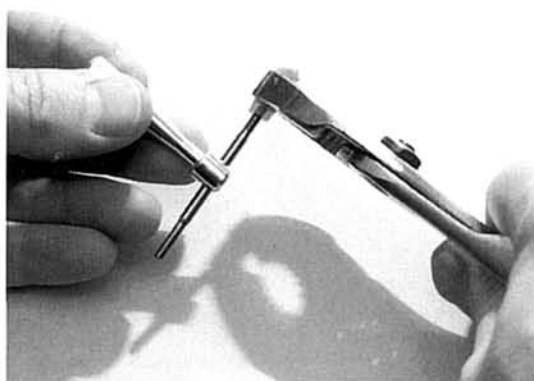
On the other hand, you must be careful not to dent them when you pop them out. Don't use a metal tool, such as a pinion wrench or an Allen wrench; use something that's softer than the ball, such as a matchstick or a piece of plastic antenna rod. I use the tool that comes with Associated's* hard-anodized shocks (to mount the seals). It's the perfect size, and I have a bunch of them from RC10 and RC10L kits.



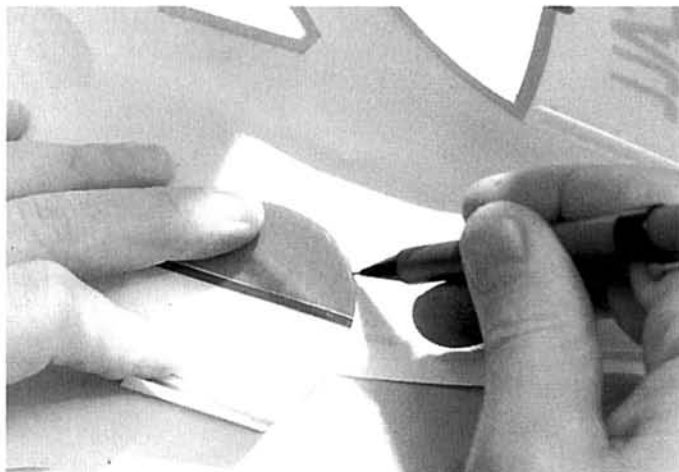
TUBING TIP

Here's a new use for fuel tubing: use it to prevent your shock shafts and nylon ball ends from becoming scarred during installation. Run a piece of large-diameter fuel tubing over the entire ball end, and grip the tubing with a pair of pliers while you turn the turnbuckle. Screw the turnbuckle in as far as you need to, and then pull the tubing off. The ball end still looks brand-new!

Shock-shaft installation has been a problem for me since I started in this hobby. You can try to wrap the shaft with paper or a rag, but it's pretty hard to prevent the shaft from turning while you try to screw on the shock ball end, and the result might be a scarred shock shaft that leads to a leaking shock absorber. Not cool! Next time, take a 1-inch-long piece of 1/8-inch-diameter fuel tubing (the smallest kind), and split it down one side with an X-Acto knife. Place it over the shock



shaft, and grip the shaft with your pliers. Screw on the ball end (note that the shaft doesn't turn at all, and if it does, just clean the tubing out with a little motor spray and try again), and pull the shaft out of the tubing through the split. I wish I had known about this one a long time ago!



WHEEL DEAL

Ever been frustrated when cutting out a body? I always cut my bodies out after I've painted them, and I discovered this trick one day by accident: cut the front wheel wells out first, and save the Lexan disks that are left over from each side. They make perfect templates for drawing the rear wheel wells, too! Mount the car body on the body posts, turn it over, mark the front and rear of the rear wheels on each side, and use the template to draw a perfect rear-wheel opening. Works for me!

*Addresses are listed alphabetically in the Index of Manufacturers on page 184.



Clutch this!

All right, so your gas car has a clutch thingy bolted onto the engine. What is it there for, and how does it work? Well, in this month's "Nitro News," I'll try to answer these questions.

A clutch couples the engine's power to the rest of the car's drive system. It allows the engine to remain running while the car is stopped, and it also delivers full power when it's called for. Without a clutch system, it would be impossible to stop the car without the engine quitting.

A full-size car with a manual transmission also uses a clutch as a coupling between the engine and drive system, but in this case, it's controlled manually. Step on the clutch pedal, and no matter which gear the car is in or how fast the engine is turning, it won't deliver the power to the wheels. Let go of the pedal, and as long as a gear is engaged, whatever power the engine is putting out will reach the wheels. If you try to stop with the clutch still engaged, the engine will conk out.



MIP's 4-N-1 clutch system uses a coil spring as a return mechanism. To adjust the engagement point of the clutch, you can add two small weights to the shoes.

R/C cars use a centrifugal clutch system. This means that at a certain rpm level, the clutch will start to engage and deliver power.

When the engine revs drop below this point, the clutch releases, disconnecting the engine from the drive train. It's totally automatic.

So now you know what a clutch does, but what about how it does it? Have you ever seen a ride at an amusement park called the "Hell Hole" or the "Rotor"? You know, the one where you're in a round room that spins faster and faster until you're literally stuck to the wall? Well, this is a perfect example of centrifugal force in action. A centrifugal clutch works on the same principle. As the engine spins the clutch and flywheel assembly, small, composite, wedge-shaped pieces called clutch shoes are forced outward. The shoes are held on the flywheel by pins that allow them to pivot outward and back. As they're forced outward, they begin to contact the clutch bell that surrounds them. The faster the engine spins, the harder the shoes press against the clutch bell. At a certain rpm level, the shoes will "lock" against the clutch bell and force it to spin with the engine. At this point, the clutch is fully engaged, and the clutch bell spins with the engine as if it were one piece.

Several factors determine how and when a clutch will engage and release. The weight of the clutch shoes is one. The heavier the shoes, the sooner they will engage; the lighter, the later. Generally, you should use heavier shoes on low-traction tracks. The heavier shoes will "bog" the engine a bit and make it harder for the wheels to break free on loose tracks, while lighter shoes will let the engine rev up into the power band for running on



This four-shoe clutch system from a 1/8-scale buggy comprises a flywheel, four shoes and springs and a clutch nut to secure it to the engine. The shims are used when you mount the clutch bell on the clutch assembly.

loamy/fluffy or muddy tracks.

You can alter the shoes' weight by "cutting" them with a knife. By removing material from the end of the shoe opposite from the pivot point, you can make the shoe lighter. The downside is that once you've cut a piece off, it's off for good. When you cut your shoes, be sure to keep them equal in weight. Look at diagram 1 for an example. The shoes in the diagram are like the ones in the Associated* RC10GT's clutch.

Some shoes, such as MIP's* 4-N-1 clutch for the RC10GT, use weights to control the engagement point. Small holes are drilled in one end to accept the small metal weights. MIP's clutch can be configured in four different ways: with or without the weights, and trailing or advanced (see diagram 2). On most clutches, the shoes are mounted so that the pivot point leads the rest of the shoe. When the shoe is reversed so that the pivot is behind the rest of the shoe, the clutch has more bite. With four options to choose from, there's a clutch setup for every type of track.

Springy Thingy

Most clutch systems use a device to help the shoes disengage quickly. On some, a simple spring is wrapped around the shoes to hold them together. As the engine gains rpm, the shoes stretch the springs and engage the clutch. As soon as the rpm drop, the spring disengages the clutch. Some use a rubber O-ring in the same fashion. On some 1/8-scale off-road cars, three or four clutch shoes are used. On these clutches, there's usually a spring for each shoe.

On Associated's two- and four-shoe clutch for the RC10GT, there are no springs. The first kits used a spring, but the team has since stopped using it. This brings a new phenomena to the clutch arena. Without the return spring, the clutch can stay engaged for a moment to help the car slow down. As the throttle is released, the shoes add drag and use the engine to slow the car down. This is known as compression braking, and it's similar to downshifting in a full-size car.

How Many Shoes?

The number of shoes varies from two to four for most applications. Why does it

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TRACKS:

We have redesigned the outdoor track this spring, keeping some of the elevation changes, but cutting away most of the hillside. Track size is 60x110 feet, with typical laps around 25 seconds. Design is fairly open, radius turns with the usual tabletops, doubles, jumps and washboards. Our new covered drivers stand fits 15 racers. We can race inside in the event of bad weather. You should bring a table, chair and power strip to the track. Pits are mostly inside.

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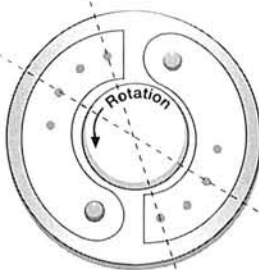


Diagram 1

matter? I'm not sure. Four smaller shoes seem to engage sooner, but because they're cut, there's less of each shoe to contact the clutch bell. I found that four smaller Associated shoes worked better than two full ones. As far as three- and four-shoe units in 1/8-scale buggies go, I find that either works well.

On the left is a pair of shoes from an RC10GT, mounted in a trailing configuration. The dotted lines show how the shoes can be cut to reduce their weight. Below is the same set of shoes in an advanced configuration

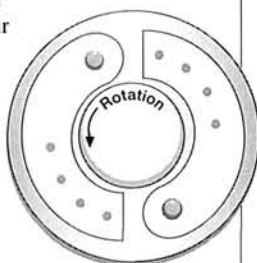


Diagram 2

Free and True

OK, so now you know what a clutch does and how it does it, but there's more you should know. It's critical that the clutch bell runs free and true. Any time the engine is running and the car is still, the clutch bell is spinning like crazy. If there's any binding, it will be difficult to stop the car without the engine conking out. Some clutch bells use ball bearings that require little maintenance to run freely. Systems with needle bearings need a good dose of grease every few hours of running to ensure that they don't bind up. If not taken care of, a needle bearing can melt, throw your gears out of whack and chew the teeth right off your spur gear. It's also a good idea to make sure that the clutch bell is shimmed to prevent excess movement. A clutch bell that has too much play might rub against the spur gear and generate excess heat.

Good luck and happy running: ■



GETTING STARTED

by Brian Leslie

Helping others out

I just received a letter that really made me stop and think about what R/C means to me. Fourteen-year-old Chris Ackerman from Maryland wrote about all the help and guidance he has received from his uncle Rick. According to Chris, his uncle is an avid R/C racer and an all-around nice guy who has given him the help and support he needed to get started.

To me, this is what R/C is all about. You just can't put a price on the kindness and guidance guys

like Rick provide. When I first started in R/C, I had no one to look to until I hooked up with a guy at my local hobby shop. He took the time to answer all my questions, no matter how stupid they might have seemed. This kind of effort is what you usually find at your local hobby dealer, so patronize them whenever possible. He also put me in touch with another R/C nice guy who always took the time to help me out when something wasn't working, or to give me a

pat on the back when things did go right, which didn't seem to happen very often.

It's people like this who keep the R/C business thriving, and I want to dedicate this column to them and to all the other people in the hobby who have helped some-

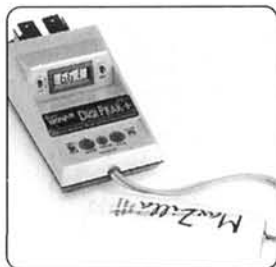
one to get started in the world of R/C!

I also want to thank all those who have been writing in with questions concerning how to get started. Here are a few I chose to answer this month.



Does trickle-charging Ni-Cd batteries hurt them or help them?

Trickle-charging isn't recommended for sub-C Ni-Cd batteries that are used to power an R/C car or truck. To achieve the best results, most 6- or 7-cell battery packs should be charged at the fastest rate possible without overcharging. For example, a 6-cell, 1400mAh pack can be charged at a rate of 4 to 5 amps. It will take about 15 to 20 minutes to complete a full charge. A peak-detector charger will perform these duties for you without the risk of overcharging. Trickle-charging is best for transmitter and receiver packs.



Which batteries are best for the radio?

I use Ni-Cds in my transmitter and receiver packs. The initial cash outlay for the batteries and the charger might seem to be a lot



when you compare it with the cost of one set of alkaline batteries, but in the long run, it's much cheaper, because Ni-Cds can be recharged.

What's a good beginner radio?

For an electric car or truck, I suggest any good sport-type radio, such as the Futaba Magnum Sport or the Airtronics RV2PS. Both have the features needed to run any electric car or truck. If you're going to start with gas, buy a radio that has throttle ATV controls. The Futaba 2PBKA Magnum Jr. and the Airtronics XL2P are great beginner radios.



What do different tire color-codes mean?

Tire companies use color codes to specify the hardness of the tire compound. On-road foam tires have this coding most often; typical colors are yellow, green and blue. Yellow, the softest compound, gives the most traction, but because they're so soft, they wear out quickly. These tires are used on smooth, low-traction surfaces such as carpet. Green is best for all-around asphalt use. Blue is the hardest compound and is

used on rough, high-traction surfaces where tire wear is a concern.

What's the difference between a stock motor and a modified motor?

A stock motor has 64 inches of 22AWG wire that has been wrapped around the armature 27 times. So a stock motor is a 27-turn single. A modified motor has shorter wire that's usually of a larger gauge. For example, the Trinity Kinwald 12-turn double has two wires that have been wrapped around the armature 12 times. Because there are fewer winds around the armature, modified motors rev more quickly and use much more power from the battery, and that means that run times will be shorter than those of stock motors. All stock motors have bushings; modifieds have bearings.



What kind of run times should I expect from my electric truck?

If the truck has been maintained well and you use a stock motor with 1400mAh batteries, you can expect to get about 6 to 10 minutes of run time. This time really depends on two things: the quality of the batteries you use, and whether the truck is equipped with

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SPECIFICATIONS**



by John Rist

Novak Racer

In our March '95 "Scoping Out," we printed an incorrect dimension and price in the specifications chart for the Novak Hammer Pro. The correct dimensions are 0.65x1.64x1.73 inches (HxWxL), and the price is \$199, not \$97.99. We're sorry for any confusion this may have caused.

Two things about Novak's* new Racer speed control impressed me before I even assembled it:

- There are no motor and battery connectors. Serious R/C car drivers either use pro-quality connectors or they hard-wire their controllers into place.

- It's equipped with monstrous 12-gauge battery and motor leads to minimize power loss.

RUNNING THE RACER

Because first impressions can be deceiving, I decided to run the Racer through the "Scoping Out" process. Removing it from its case is easy; simply remove two plastic snap rings from the ends of the case.

Inside the case is a miniature computer attached to a massive bank of current-handling FETs. Almost all high-frequency speed controls today are microprocessor-controlled. A computer chip looks at the signal coming from the receiver (typically at a 60Hz rate) and converts it into the high-frequency signal that's needed to control the FETs. Many other features—such as glitch filtering and current limiting (also known as torque control)—are possible if you have a microprocessor design.

As in all Novak products, the workmanship is excellent. To make room for all its parts, the Racer has a piggyback board that sits on a riser.

To see whether the Racer would measure up to the exciting performance numbers in its specifications sheet, I took it to my lab. Because it has Novak's One-Touch Setup™, all I did was plug it into my Pit Stop Radio (a piece of test equipment that puts out the same signal to a servo or speed control as a receiver would supply), and press the One-Touch button. It's really that easy.

TEST 1—RESISTANCE

With 12 amps of current flowing, I measure the voltage drop across the ESC and then calculate its "on" resistance by dividing the measured voltage drop by 12. I measure resistance twice—along the full length of the motor wires and battery wires (including connectors) and 2 inches along them. The first reading helps me to determine an ESC's "on" resistance as it comes from the factory, and the second gives a standard reading with which I compare ESCs. It's virtually impossible to directly measure the resistance of an operating speed control, so I measure the voltage drop across it with 12 amps of current flowing and calculate the resistance.

- *Voltage drop along the full length of the battery and motor wires:* 0.07 volt—a resistance of 0.0058 ohm.

- *Voltage drop 2 inches along the battery and motor wires:* 0.05 volt—a really low resistance of 0.0041 ohm.



What it Has

- High-frequency racing speed control (forward and brakes).
- Eight FETs (five for forward, three for brakes).
- One-Touch Setup™.
- Easy-to-set current control.
- Automatic thermal shutdown.
- Reverse-battery protection.
- Radio-priority circuitry.

Also included with the Racer is a hot decal set, heat sinks, three motor caps, a Schottky diode, 9 inches of 12AWG monster wire (red), mounting tape, receiver plugs for all popular brands of radio and a spiffy little tool to press the recessed One-Touch Setup™ programming button.

TEST 2—OVERHEATING

I "cook" every controller I test by adjusting the resistor bank to pass 20 amps of current, jamming the throttle wide open and running the ESC for 15 minutes while it pumps a hefty 20 amps. The heat sinks are in place, but there's no cooling air.

I let the Racer run for 15 minutes—the equivalent of dumping three or four battery packs without any cooling-off periods. After 15 minutes, the Racer was barely warm. When you have only 0.0058 ohm of resistance, overheating shouldn't be a problem. I calculated that the Racer was dissipating only 1.4 watts of power while it was handling 20 amps. The Racer could handle this amount of power indefinitely—especially if it has some cooling air.

TEST 3—HANDLING A SHORT

In my dead-short test, I check to see whether an ESC could survive the heavy current it would have to withstand if a gear jammed or the motor fried. I short the motor leads while the ESC is fully turned on. The current jumps to a hefty 40 amps. Under these conditions, the FETs started to heat up, but they didn't get hot enough to kick on the automatic thermal shutdown. Besides, the heating is probably caused by low supply voltage, not high current. This low-voltage condition causes the FETs to come out of saturation (less than full "on"), and that increases their resistance. This can cause destructive heating, but the Racer handled my abuse.



Novak Racer

DIMENSIONS

Height	0.65 in.
Width	1.64 in.
Length	1.73 in.
Weight (w/wires and heat sinks)	2.7 oz.

TUNING

Access to controls	Excellent
Ease of adjustment	Excellent

LIST PRICE/

WARRANTY	\$160/90 days
----------------	---------------

MANUFACTURER'S SPECS

Max. voltage	10 cells
Min. voltage	4 cells
Continuous current	300A
Resistance	0.0030 ohm

TEST RESULTS

Voltage	6 volts
Current	12 amps

• Voltage drop

—along length of battery and motor wires	0.07 volt
—2 inches along wires	0.05 volt

• Calculated resistance*

—along length of battery and motor wires	0.0058 ohm
—2 inches along wires	0.0041 ohm
BEC voltage 6-cell pack	5.96 volts

*Resistance = voltage drop ÷ current

COMMENTS: with the Racer, Novak has, once again, introduced a racing speed control that's capable of winning big races. The only difference I could find between the Racer and Novak's top-of-the-line Hammer Pro was that the Racer's FETs have a slightly higher resistance. Yet, because the Racer has monstrous 12-gauge battery and motor wires as well as massive amounts of copper on its printed-circuit board, its overall resistance is still world-class low.

Other features that make the Racer a winner are its One-Touch Setup™, a convenient current-limiting control and high-frequency motor control. There's no doubt that the Hammer Pro will show up in the winners' circle, but the Racer is also strong enough to give the competition a run for its money—and at a lower price.

INSTALLATION

Time for some fun! I installed the Racer in my RC10; it's the older Team Car version, so it has a carbon-fiber chassis. Because the carbon-fiber chassis can make the car susceptible to glitching, I have my receiver mounted on the rear shock tower. That meant I had to mount the Racer on the chassis, right next to the battery. Because the Racer is so small, it was easy to "shoehorn" into this tight place. I mounted it as far back as I could—to keep the motor leads as short as possible.

TRANSMITTER MATCHING

The Racer was easy to match to my Futaba Magnum AM radio; all it takes for a perfect match is a simple press of the One-Touch Setup™ button, a squeeze of the trigger to full throttle, a push to reverse and a release of the trigger to neutral.

I headed to a nearby parking lot, where I gave the Racer its first run (with a 6-cell pack). My car is powered by an out-law stock motor called the "Psychotic Reaction," and it has a 13-turn double wind (but, unfortunately, it's no longer

available). I like to use it as a test motor because it was cheap, and it abuses speed controls like a modified motor would.

When I set the car down and hammered the throttle, the car did a wheelie. Once the front wheels had settled back to the ground, the car flew. I then picked out an imaginary roadcourse outlined by the yellow parking lanes. I'm not the greatest driver in the world, but the Racer's super drivability made it easy for me to keep it between the lines; also, acceleration was awesome, top speed was great, and the brakes were strong, yet controllable.

On the second battery pack, I played with the current limiter. It had been set to "off" with the first battery pack, and that had eliminated all current limiting, which, in turn, gave the car maximum punch. (Wheelies are fun, but they don't win races.) To check the Racer's range, I turned the current to 20 amps (minimum-punch setting). When I jammed the throttle to the floor, the car accelerated smoothly but lacked any real zip; it did seem, though, that it was still pretty much reaching full speed. I continued to advance the current-limit setting, and by the time I

reached the 70A setting, the Racer's acceleration was back to explosive, and its speed was hammering. I think that the current limiter on the Racer has enough range to allow you to match it to any track conditions that might exist anywhere in the world. And with a handy knob and a calibrated dial, it couldn't be any easier to set.

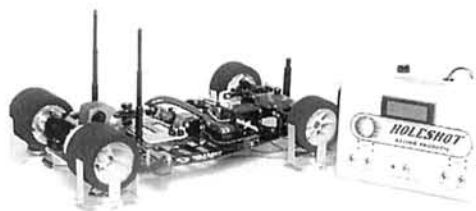
CONCLUSION

The Racer is a first-class racing-style speed control (no reverse) that's capable of winning races. Because of its very low resistance, it should never have an overheating problem. Also, because of its low resistance, it can handle modified motors.

If you've been considering a Novak Hammer Pro, but it's a little pricey for your budget, consider the Racer. The two controllers are very similar, but the Racer costs less and offers only slightly less performance. I doubt that anyone but the top pros would be able to tell the difference, especially in the stock class. And remember, the Racer performs better than top-of-the-line controllers of just a few years ago.

*Addresses are listed alphabetically in the Index of Manufacturers on page 184. ■

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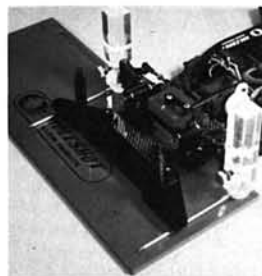
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There's only one Jeep

A LOT OF companies make R/C cars these days. Some are considered to make the best on-road machines; others, the best off-road thrashers. No matter which company is your favorite, when it comes to realistic-looking R/C cars, you have to think Tamiya! Tamiya makes perhaps the most complete line of scale R/C cars, from Formula 1 cars to buggies to monster trucks. Now Tamiya has a new line that's right in with the latest auto craze—four-wheel-drive (4WD) sport-utility vehicles (SUVs)! The new 1/10-scale Jeep Wrangler is one such newcomer. This full-time-4WD, electric car is a perfect example of what makes Tamiya one of the hottest contenders in the R/C field!

KIT FEATURES

Though the Wrangler isn't a pro racing machine, it's very rugged and well worth owning. It actually has the same chassis design as Tamiya's Mitsubishi Pajero. The Wrangler's backbone is a rigid plastic tub-style chassis. Anyone who has ever owned a Tamiya car will know that the plastic parts are about as solid and well-crafted as you can get. A 540 motor in the center of the chassis

cranks out
the power

to drive both the front and rear wheels. Up front, an enclosed gearbox directs power to a massive U-jointed propeller shaft that meets a free-floating

separate, metal, bevel-gear diffs, and if you plan to run the car on slippery surfaces, you can build the rear diff so that



rear-axle assembly.

The rear axle is held in place by two trailing arms and two oil-filled shocks. Both the front and rear wheels have

it will lock. The kit comes with plastic and metal bushings, but Tamiya offers a full set of bearings as an option. Perhaps the greatest feature is the rigid, molded styrene body with separately molded, plastic, tinted windows. I have a

full-size Jeep
Wrangler, and I

TAMIYA

Jeep Wrangler

by JONATHAN BIEBESHEIMER

must say that Tamiya nailed it with this body!

One option I couldn't resist was Tamiya's complete light set.

The headlights and fog lights are molded so that you can snap bulbs into them very easily. I was inspired by the "R/C Doctor" column in the February 1995 issue of *Car Action*,

a set of lights in about an hour, and it cost less than \$15!

TEST GEAR

To get the Wrangler going, you'll have to add a few things in the electronics department. The kit comes with a mechanical speed control. It has reverse, which is good, but I prefer to use an electronic speed control (ESC). The instructions give installation directions for both, so the choice is yours. I

1024 (FP-T3PB) radio. I recently got a couple of Trinity's* new EX-SPEC R/C Street Packs, so I charged them up, grabbed my gear, and headed outside for some serious testing!

PERFORMANCE

I was especially curious to see how the Wrangler handled in comparison to my full-size Jeep.

I began my testing on road, and I was surprised to find that the car did, in fact, capture the driving style of a real Jeep.

The short wheel-base allowed exceptionally tight, quick turns: too quick, and over it went, just like the real thing! Though the steering servo I used wasn't

the fastest, it prevented the car from being too sensitive for its own good! Acceleration with the ESC was very good, but the stock 540 didn't make the Wrangler set any land speed records! Anyone who plans to use this as an on-road speedster should consider Tamiya's RS-540 Sport-Tuned Motor or another similar modified motor.

and I decided to wire my own set of lights.

With the help of the article for directions and Radio Shack for the supplies, I installed

used an SCI* Viper Microprocessor ESC, a Futaba* FP-R113IP receiver, a Futaba FP-S130 steering servo and my standard Futaba PCM



PHOTOS BY JOHN HUBER AND WALTER SIDAS





The BBS rims come molded in gold, but I painted them silver to match my full-size Jeep's wheels. I wish that, instead of the plastic wheel cover, Tamiya had included another tire and rim for the spare.

For me, the true test of the Wrangler was in the dirt. It is, after all, an SUV, right? I have to say that off-road, this car

The BBS rims come molded in gold, but I painted them silver to match my

ity to tackle many different obstacles and types of terrain. The free rear axle allowed the car to maintain an even ride on uneven

THINGS YOU'LL NEED

The Wrangler kit comes almost ready to run, including the motor and the mechanical speed control. Here's what you'll need to finish it off:

- 2-channel radio system (including a receiver)
- Steering servo (make sure it's powerful enough to handle rough terrain) and a servo for the mechanical speed control
- 6-cell battery pack
- Battery charger (to charge the 6-cell battery pack)
- Paint

handled about as well as any R/C vehicle I've driven! I was truly

amazed at its abil-

slopes, and in situations where the tires were at different heights, such as when I drove it over big rock beds. Though the

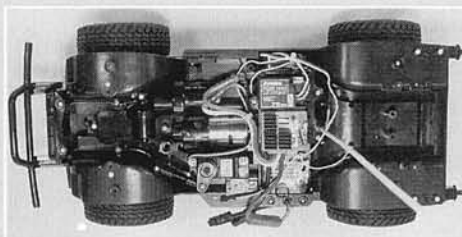
BUILDING AND SETUP TIPS

Building a Tamiya car is always a lot of fun, and this car is no exception. The instructions are very specific and very easy to read; they come with a helpful list of parts used in each step and a drawing of each part. The parts are bagged and labeled by type. Because some of the bags were really packed full, I found it easiest to use the "muffin-tin method" when building: I went through the instructions and put the parts required for each step into separate cups of a muffin tin. This saved me from the agony of using the wrong screw at the wrong time, only to discover the mistake when the car was almost finished! Sound as if I'm speaking from experience? Hey, I learned that lesson the hard way!

Construction is straightforward, and, if you're careful, you shouldn't have many problems. The first step is prepping the motor. To ensure a proper fit with the other gears in the tranny, make sure that the pinion gear is attached correctly to the engine shaft. A special spacer (included) will help you install the gear in the proper position. Also, when you attach the plastic motor mount, make sure that you use the correct holes.

The next few steps involve the front diff and the main gearbox. Again, to ensure a good gear mesh, be sure to follow the diagram on the drive gear. Though it seems as though the gear fits both ways on the shaft, it's designed to slide on just one way. Both front and rear diffs are bevel-gear, and clear diagrams help you to assemble them correctly. Note, however, that the rear diff can be fully locked by adding the parts labeled "G5." Locking the rear diff is suggested if you plan to run the car in slippery conditions. It's not critical that the diff be assembled one way or another (locked or unlocked); you can change it later, but it will take a little work to get to it.

I was particularly interested in the Wrangler's propeller shaft. On other Tamiya 4WDs I had built, the shaft was about the thickness of a coat hanger. The ends of the propeller shaft were joined to shafts on the front and rear gearboxes in a way that I always thought was adequate, but a little sad (usually with a piece of fuel tubing). The Wrangler, however, has a shaft to beat all shafts! It's made entirely of metal, and it's a good 1/4 inch in diameter. Two sets of metal U-joints are used, because the rear gearbox has to move in relation to the front gearbox. Although the instructions say that thread-lock isn't required, I used a little on the three setscrews that hold the propeller-shaft parts in place.



Although the Jeep has an intricate 4WD system, there's plenty of room on the chassis for the electronics. Notice that the motor is mounted in the center of the chassis.

TAMIYA JEEP WRANGLER

Scale 1/10
List price \$300

DIMENSIONS

Overall length 17.5 in.
Wheelbase 9.75 in.
Front width 7.5 in.
Rear width 7.5 in.

WEIGHT (gross, RTR) 3.75 lb.

CHASSIS Molded-plastic tub

DRIVE TRAIN

Type Gear
Primary Pinion/spur
Transmission Gear
Differential (F/R) Bevel gear
Slipper clutch None
Bearings/bushings Metal and plastic bushings

SUSPENSION

Front Lower swing arm/upper link
Rear Free-floating axle with trailing arms
Damping Oil-filled, coil-over

WHEELS (F/R)

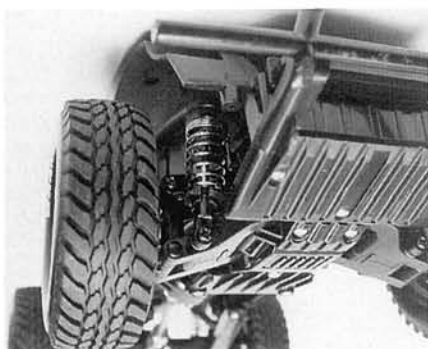
Type One-piece plastic
Dimensions (DxW) 2x1.125 in.

TIRES (F/R) Semi-pneumatic off-road block tread

ELECTRICS

Motor Stock 540 (included)
Battery Not included
Speed control 3-speed mechanical (included)

OPTIONS TESTED: Futaba PCM 1024 (FP-T3PB) radio; Futaba FP-R113IP receiver; Futaba FP-S130 throttle servo; FP-S130 steering servo; SCI Viper Microprocessor; Trinity 6-cell EX-SPEC R/C Street Pack.



Up front, the Jeep has an independent suspension with upper and lower A-arms. The large treaded tires look exactly like the Goodyear Wrangler tires that come on full-size Jeeps.

Factory options

Though the Wrangler is great right out of the box, you might want to trick it out with some of Tamiya's special options:

- A full set of sealed bearings to replace the kit's plastic and metal bushings;
- Titanium screw sets to replace the kit's steel screws;
- R/C lightbulb set to light up headlights and fog lights;
- RS-540 Sport-Tuned motor for more power!

stock 540 seemed sluggish on road, it didn't lack power for the challenging rides I was taking: up hills, through ruts, through grass and weeds, over branches, even along the top of a stone wall!

I didn't really push the car too far in the jump department, because I could tell by the way it handled that it wasn't

really designed for that purpose. Hmm...OK...maybe just one

Tamiya has successfully combined many great aspects of R/C building and driving into one affordable car.

big jump! As I watched my Wrangler fly through the air,

spin, nose in, hit the ground and roll about 7,000 times on impact, I got a chilling lesson in Jeep aerodynamics. On the bright side, at least I know not to try that with my full-size one!

As it got dark, I flicked on the light set, and the fun continued!

At longer distances, the lights won't allow you to see a lot in front of the car, but they do allow you to see the car

• Solid, well-crafted parts ensure that the Jeep is easy to build and will take a serious beating!

• Incredibly realistic molded body.

• Cool details, including the optional light set for headlights and fog lights.

DISLIKES

• Slightly underpowered on-road with the stock 540 motor; off-road, there isn't such a problem.

• The headlights and fog lights can light up; why not make the taillights work, too?

BODY WORK

On this kit, my greatest challenge was the body work. I'm used to painting Lexan bodies (spraying the inside of the body), but the Wrangler has a styrene body that must be painted on the outside, and paint used for Lexan won't adhere properly. Tamiya makes the "correct" paint in spray cans, but it's very difficult to find. Perhaps the easiest route is to use Testors paint. Testors makes a full line of paint for use on styrene bodies, and you can find it at almost any hobby shop. Take the easy route? Me? Never! I decided to go a third route, which led me on a wild goose chase, but, in the end, I had a killer body. Interested? Read on!

As I mentioned earlier, I drive a full-size Jeep Wrangler, and I was determined to make the Tamiya body match it as closely as I could. The first step was a color match. Because the Testors colors were only close, I looked into automotive touch-up paint. I highly recommend auto paint; the can's fine spray makes it very easy to get precise, even coats. I got the color code from my car (which, for any Jeep owners, can be found on the left side of the firewall under the hood) and went in search of the color. After many phone calls and trips to different stores, I finally found my color in a Dupli-Color brand.

After lightly sanding and washing and thoroughly drying the body, I gave the Wrangler more than six light coats of paint before I was



happy with the finish. Follow the directions on the can; I painted a coat about every half hour. I then added two thicker coats of Dupli-Color clearcoat and let it dry overnight.

When it came to the hardtop, once again, I was determined to make it look as real as I could. I started by masking it with Scotch Long-Mask masking tape; I was told that it was a good choice because it was less likely to remove the paint it was stuck to. Another important masking note: be sure that the car is masked all the way around, including underneath!

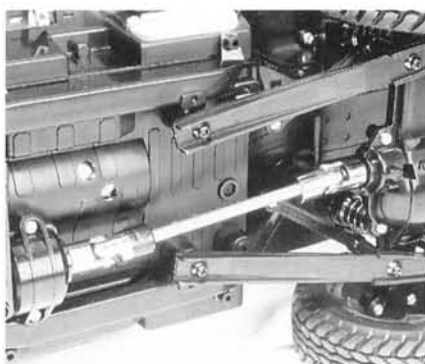
Because you haven't installed the windows yet, it's possible for paint dust to drift in underneath the car, go through the holes for the windows, and wreck the perfect paint job you just spent a day on!

I wanted to add more texture to the hardtop, so I bought a can of Stone Craft stone texture spray at a hardware store. With the can about 3 feet away from the hardtop, I gave it an even, but light, coat of spray. After ample drying time, I applied five light coats of flat-black automotive primer to finish it off.

For the bumpers and remaining details, I used bottles of Testors paint (flat-black, orange, red and chrome silver) and lots of patience! When I finally finished the body, I was very pleased with the results. Although the auto paints and hardtop detail are fairly expensive (I spent about \$40), they make the car look incredibly realistic!



The Wrangler's rear differential is enclosed in this full-floating rear "pump-kin." Tamiya's plastic-body, oil-filled shocks work well on all types of terrain.



Power is transferred to the rear end through this massive drive shaft that looks as if it was made for an 1/8-scale gas car. Next to the forward universal, you can see the bulge in the bottom of the chassis for the motor.

itself, which is a big plus! Be sure you know the area you're running in at night, though; you'd be surprised at how fast the car stops when you plow into a tree you couldn't see! Ouch!

FINAL THOUGHTS

I give the Wrangler a big two thumbs up. Tamiya has successfully combined many great aspects of R/C building and driving into one affordable car. The molded body allows detail-minded modelers to create an incredibly realistic-looking vehicle. The car's design allows really fun runs, and again, it also provides the realistic feel of a Jeep. My test runs proved that there's very little this car can't handle, and that makes it ideal for anyone looking to get into R/C cars. And best of all? If you compare the price of this car with that of buying the real thing, you'll save about \$15,000!

*Addresses are listed alphabetically in the Index of Manufacturers on page 184.

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C&M Team Cobra Nemesis Sprint Car

by Doug Mertes

ALL ACROSS AMERICA, on warm summer Saturday nights, you can hear them. Unmuffled exhaust headers and short pipes simply can't hide the sound of a hot, light-flywheel, high-compression V8 engine at full song. Put that kind of sound and power into a short-wheelbase, light-weight, tube chassis with just enough body to cover the driver

and protect the motor from flying debris, and you have the uniquely American sport called "sprint-car racing"!

Sprint cars represent the ideal in racing cars: an incredible amount of horsepower and the ability to control it—just barely—and still keep the car shiny-side up. Drivers duke it out in the turns and down the straights, bumping and elbowing their way through the field. At many tracks, the top qualifiers start at the back of the field during the Mains! That's why the cars have those complex, protective roll cages. The tracks are typically narrow, short, banked, dirt or clay ovals, and there's a lot of contact between cars. We all know what happens when two open-wheel cars get together at speed, right? One or both go tumbling down the track, sometimes rolling sideways while they travel forward (that's called a "barrel roll"). Sound exciting? You bet it is!

I'm just as excited about the Nemesis Sprint Car from C&M/Team Cobra*. It's a 1/10-scale version of that same fast racing-car ideal: you can put in an amazing amount of horsepower, and the car is so sweet and so adjustable to every surface that you can keep it under control. In fact, the closer you can get to the "just barely under control" part, the faster you'll go!

Specifications

Scale 1/10
List Price \$449

DIMENSIONS

Overall length 16.75 in.
Wheelbase 10.88 in.
Front width 8.65 in.
Rear width 9 in.

WEIGHT 3 lb., 6 oz. (ready to run
w/6-cell pack)

CHASSIS

Type Double-deck
Material Fiber-reinforced graphite

DRIVE TRAIN

Type Semi-sealed direct drive
Primary Pinion/spur
Transmission None
Differential Ball diff
Slipper clutch None
Bearings/Bushings Bearings

SUSPENSION (F/R)

Type Lower A-arm with upper camber link
Damping Oil-filled, hard-anodized-aluminum shock

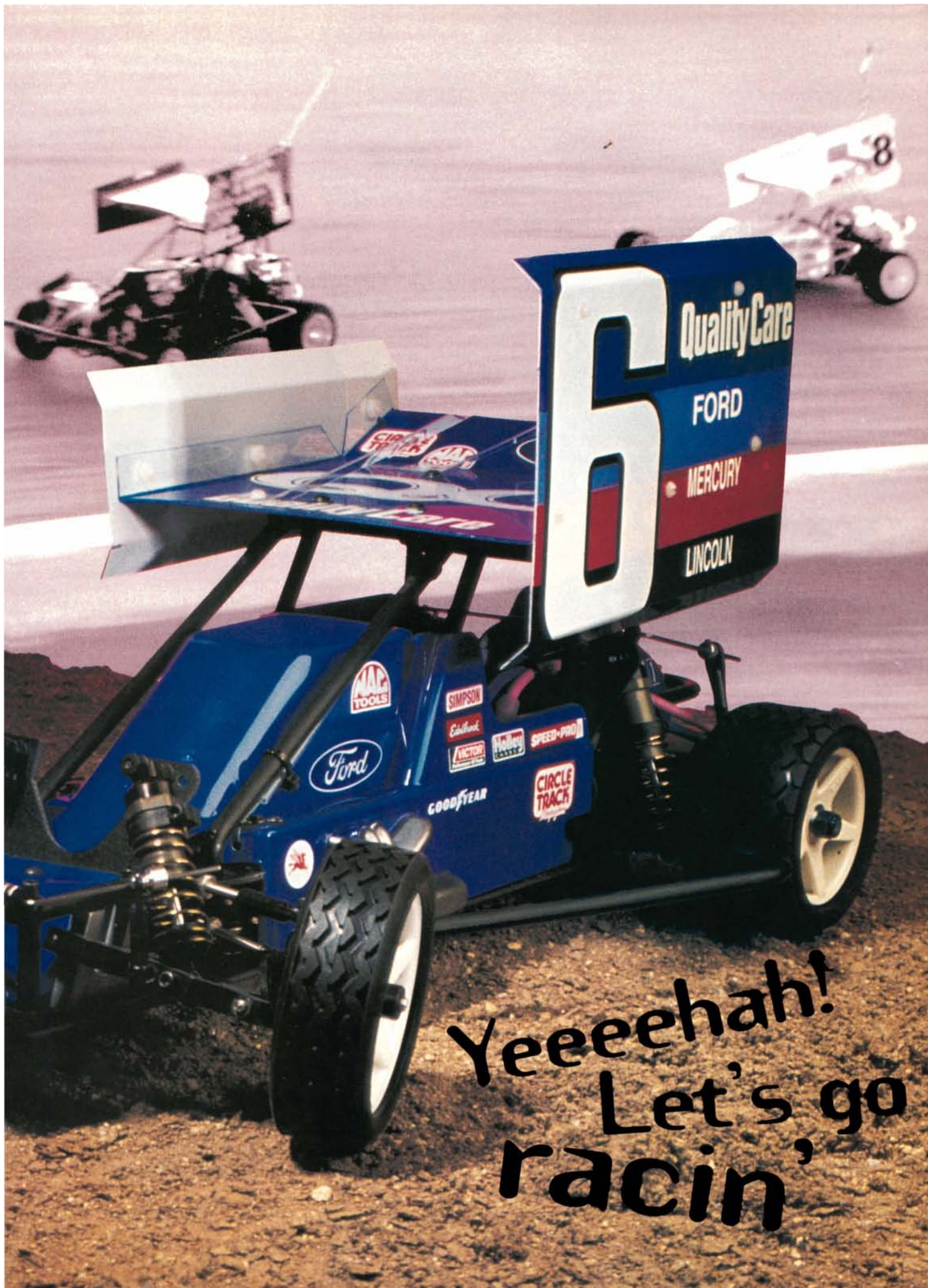
WHEELS (F/R)

Type None supplied, uses Losi JR-X pattern

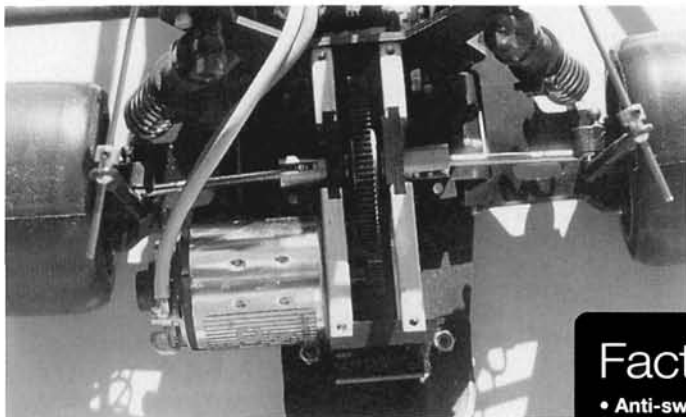
TIRES (F/R) None supplied

PHOTOS BY DOUG MERTES AND WALTER SIDAS





Yeeeehah!
Let's go
racin'



See how simple and efficient the tranny is? All of the motor's power goes to the ground.

One of the many neat things about the Nemesis is that it has been designed with an incredible number of adjustments for traction and roll-rate control, so it can handle any way you want it to on virtually any surface. Using different types of tires, shock fluid and springs, and accessory sway bars, and with some assistance from manufacturers and fellow racers, I was able to run the car on carpet, loose dirt, asphalt and concrete.

KIT FEATURES

The quality of the components is first-rate, from the machined Delrin suspension arms, cage mounts and transmission inserts, to the titanium turnbuckles, the

THINGS YOU'LL NEED

The Nemesis is a high-quality, purpose-built rolling chassis, so you'll need a full set of electronics: ■ 2-channel radio system, preferably with dual-rate steer-

ing control, with one servo for steering (a servo with a small case fits best). ■ 6- or 7-cell in-line battery pack. ■ Motor and pinion. You can use a stock motor, but a budget modified isn't any more expensive, and

it's a lot more fun. ■ Electronic speed control. ■ Battery charger. ■ Set of wheels and tires for your specific surface (none is included). ■ Shock oil.

ball-bearing steering linkage, the smooth differential, the graphite and the nylon. This is a car that you'll enjoy building and will be proud to own for a long, long time.

Everything is organized in numbered bags, and the instructions take you step by step through building. A separate manual has CAD-type illustrations of each step. Although the manuals could have been a little more polished, I had no trouble building the car.

The car's foundation is a rigid, close-weave-graphite, double-deck chassis with battery slots for up to seven cells. I filed the slot edges on the top side of the chassis, including the slots for the battery straps, with a sanding drum on a Dremel tool. Then I attached the upper deck with the supplied black-anodized-aluminum standoffs and 4-40 screws. The steering linkage is designed so that the



Note the upper hatch cover which is held in

place by the two forward screws, and the Lexan cover, which keeps the dust and dirt away from the smooth ball diff.

Factory Options

- Anti-sway bars are available in several thicknesses from Cobra. The thicker the bar, the greater the resistance.
- Rear toe-in blocks in 0, 1.5 and 3 degrees are available from Cobra and Associated.
- Black (soft), Green, Silver and Red (hard) shock springs are available from Associated; Cobra also makes super-hard 20-pound springs.
- Short front A-arms (no. 71086) increase steering.
- Stealth transmission adapter (no. 71085) for clubs that require a gear-reduction tranny.
- Cobra Pro Series modified motors.

With a sprint car, the fastest way around the track is to set it up to always slide just a little on all four corners in the turns. The Nemesis makes that easy, because it provides so many tuning adjustments. These tips will get you in the ballpark with your car, but you'll have to experiment with different settings until you're comfortable with how it handles. Start by setting the car to the "neutral" setup described in the detailed tuning manual.

To start, use the flat upper wing setting. For additional down-force, raise the rear of the wing by using longer 4-40 socket-head screws and short sections of rubber fuel tubing. The upper wing actually creates a pillow of air that helps to prevent the car from spinning out. If you don't think it works, try running the car without it. You'll be amazed at the difference!

You can increase or decrease traction at any corner of the chassis independently of the other three corners. This is done with shock fluid (thicker equals less traction and slower response; thinner equals more traction and faster response), shock springs (heavier/stiffer springs equals less traction and faster response; softer/lighter springs equals more traction and slower response), piston-hole size (smaller equals less traction and slower response; larger equals more traction and faster response) and shock angle (more upright equals less traction; laid down equals more traction).

You can also adjust the car's other corners with spring preload. This is called "wedge." Wedge always affects the shock on the opposite corner of the chassis, i.e., preload on the left rear corner affects the right front corner of the car. Because each corner takes on a unique role in the car's handling through a turn as weight is transferred, you'll do well if you master this tuning technique.

If the car pushes entering a turn, tighten the left rear spring. This reduces traction in the left rear, and allows the right rear, with more traction, to turn the car into the turn. At the same time, weight will be transferred onto the right front wheel earlier in the turn, and the chassis will track through the entry more easily.

If the car enters a turn too easily and hooks, tighten the right front spring. This will reduce traction on that wheel and add weight to the opposite corner. More traction in the left rear will prevent the car from steering too easily early in the turn.

If the car pushes exiting the turn, tighten the right rear spring. This not only reduces traction on the right rear tire, but increases weight on the left front, which tends to be on the light side when the car is exiting.

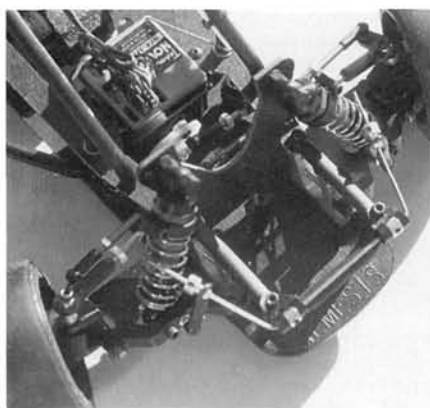
When the car exits a turn, if it keeps turning instead of coming out of the turn straight, tighten the left front spring. That will reduce steering on exiting and add traction to the right rear, which will make the car go straight as it comes out of the turn.

Front and rear toe-in are also important tuning aids. More toe-in equals more traction, so more front toe-in yields more steering. Too much front toe-in will make the car twitchy; none at all reduces front-wheel resistance to a minimum. A little front toe-out will sometimes quiet the steering down on a very slippery track. More rear toe-in yields more drive-train traction, but too much will slow your car down. Use less rear toe-in on high-traction surfaces. You can even use more rear toe-in on the right side than on the left side. This is called "rear steer," and, when used properly, it can help a car get around a corner at high speed.

You can also make the car turn more easily by using a larger tire/wheel combination on the right rear than you do on the left rear. This works well on almost any surface, because the right-side tires have to travel a greater distance than the left-side tires in any given left-hand turn. The ideal amount of difference, called "stagger," will be different for each track, according to how sharp the turns are.

NEMESIS SPRINT CAR

servo can be nestled between the forward standoffs. This allows more room for the electronics. The rest of the front end goes together without a hitch; it's pretty standard stuff. The steering spindles and caster blocks are very similar to Robinson's 18-degree off-road system, in which the king-pin's drive angle is pointed at the front tire's contact patch. It's a technique commonly used on front-running oval cars, because it works very well.



Machined Delrin front arms, Associated shock absorbers and Quarter Flash anti-sway bars provide a solid, adjustable front end.

The nylon roll cage is next, and it's a little more complex. Remember to inspect all the parts for those little plastic tabs left over from the molding process, and shave them off carefully with an X-Acto knife. If you accidentally cut through the dyed part into the white area underneath, mark it with a black Sharpie pen, and it will blend in nicely with the rest of the part.

Next, assemble the direct-drive transmission, including the 96-tooth, 48-pitch spur gear and differential. My kit had the updat-

ed diff halves that use full-size diff rings; earlier models used Stealth-size rings that weren't as smooth. The diff in this car is as smooth as glass, and, because the gearbox is enclosed, it should stay that way through many runs. The instructions tell you to attach the upper case cover with double-sided tape, but I drilled two holes in it and bolted it to the gear case with the two forward 4-40 socket screws. It's easier to set the gear mesh that way, because you can rock the spur with your index finger.

I also made a little Lexan hatch cover for the right side where you access the motor screws. The cover is held on with the upper right button screw on the case's rear, and it helps to keep dust and stones away from the spur gear and differential. The rest of the rear end is easy to put together. If you've ever built an off-road car or truck, this lower A-arm/upper camber link design will look very familiar!

The shocks are Associated's* excellent hard-anodized units: 0.056s up front and 0.071s in the back. Accessory pistons and springs are as close as your local racetrack or hobby shop. Gold springs are fitted all around, as is Associated's top-quality mounting hardware, which has been

LIKES

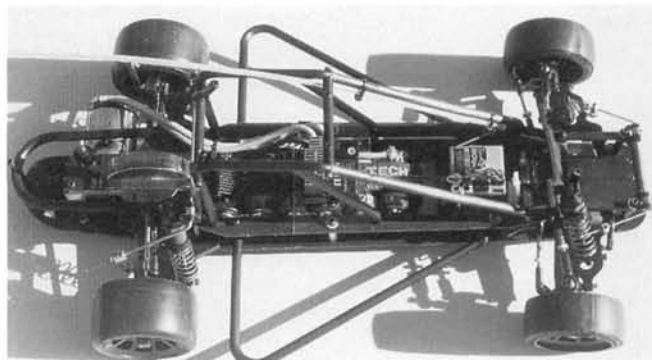
- Too much fun! When does the racing start?
- Probably the highest-quality kit I've put together in years.
- Looks incredibly realistic; really draws a crowd when it runs.
- Can be set up just like a full-size version; great tuning manual included.

DISLIKES

- Instruction manual needs polishing up; combining the illustration and text portions would help.

dyed black to match the rest of the car's parts.

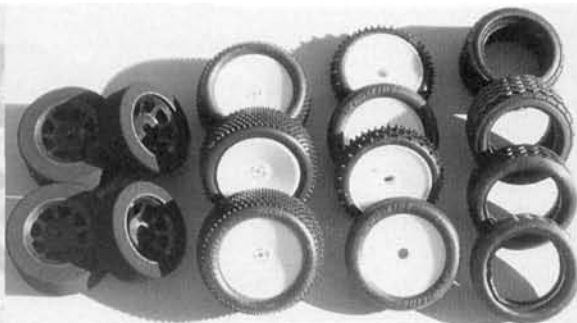
Both the front and rear suspension have several upper and lower mounting holes with which you can adjust shock response. With the kit's adjustable collars, you can set spring preload very precisely. The aluminum front-suspension-arm mounts



Things are a little tight on the double-deck graphite chassis, but you can mount the ESC on a Lexan shelf above the batteries; a mini-receiver fits nicely on top of the steering servo.

NEMETEST

I ran the Nemesis on four test surfaces: a flat, hard-packed, but dusty dirt oval; a flat carpeted area; a smooth, slick concrete surface; and an unprepared but fairly new, flat, asphalt parking lot. Surfaces that vary this much require different tire and suspension setups, so I contacted Dave Underwood at TRC* and Todd Mattson at Pro-Line*. Both were very knowledgeable about the car, and they were able to fill me in on the hot setup for all four surface types. These are the tires I used on the four surfaces. I suggest that you start with these and experiment to get more or less traction at your particular track.



Pin spikes, ribs, foams, caps and treaded tires are all part of the sprint-car-racer's tuning toolbox.

DIRT

- **Front**—Pro-Line no. 8015 Rib (XTR compound) on no. 2531 Pro-Line 2.1-inch wheel; Pro-Line no. 7085 Spike "Worlds" front tire on no. 2531 2.1-inch wheel (for loose surfaces).
- **Rear**—left side: Pro-Line no. 8135 pin-spoke on no. 2578 2.1-inch wheel; right side: Pro-Line no. 8083 or 8082 pin-spoke on no. 2578 2.1-inch wheel (no. 8082 yields more stagger than no. 8083).

ASPHALT

- **Front**—Pro-Line Striker IV no. 1055 front treaded tire on 2.1-inch wheel.
- **Rear**—left side: Pro-Line no. 1051 Striker I rear treaded tire on 2.0-inch wheel; right side: Pro-Line no. 1050 Striker II Truck rear treaded tire on 2.2-inch wheel (for stagger, if desired).

CONCRETE

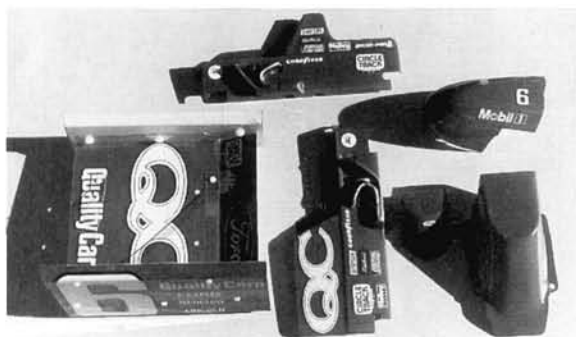
- **Front**—TRC capped tires in Yellow compound.
- **Rear**—TRC Capped tires in Gold or Green compound.

CARPET

- **Front**—TRC no. 1851 Green-compound foam front tires; TRC no. 1854 Yellow-compound foam front tires.
- **Rear**—TRC no. 1951 Green-compound rear foam tires; TRC no. 1952 Yellow-compound rear foam tires.

should prove indestructible. The rear suspension has anti-squat built in. With no bump-steer in the front geometry, there are no surprises entering or exiting fast, sweeping turns. This is pro-level equipment!

The last step is to cut out, fit and paint the six (!) Lexan body parts. Take your time during this step, because sprint cars attract a crowd, and the body is the first thing people will see. I chose a Ford Quality Care paint scheme, but there are many oval- and stock-car color combinations that look really zippy. Because of the high-contact nature of this segment of the sport, many sprint cars are painted in a single bright color and decorated with sponsor logos and decals because they're easy to replace.



If you cut and fit the six body panels before you paint them, you'll wind up with a better finished product.

The Competition

Vehicle	Team Cobra Nemesis	Custom Works Enforcer	Trinity Reflex-10
Wheelbase.....	10.88 in.	11 in.	11.125 in.
Front width.....	8.65 in.	9 in.	9.5 in.
Rear width.....	9 in.	9 in.	9.5 in.
Weight RTR.....	54 oz.	55 oz.	55 oz.
Chassis material.....	Graphite	Graphite	Graphite
Differential.....	Ball diff	Ball diff	Ball diff
List price.....	\$449	\$499	\$399*
Find for.....	\$260	\$330	\$260 **
Reviewed.....	3/95	11/92	7/92 ***

* List price of base kit only; does not include sprint-car conversion.

** Includes price of sprint-car conversion.

*** Test of base kit only.

TEST GEAR

I equipped my Nemesis with a 6-cell Trinity* Sanyo 1700 SCRC World Tech matched battery pack, held together with Shoe-Goo in an in-line configuration. I used Trinity's Lennon Lug battery bars, and I hard-wired the pack to a Tekin* 411P speed control, which I mounted on a Lexan shelf that's bolted to the upper chassis deck. The 411P's torque control and regenerative circuitry gives me additional tuning capability, while its high-frequency switching prolongs the life of the Trinity Psychotic Reaction 13-turn, bushing, modified motor. A Futaba* 132S steering servo with a Kimbrough* servo-saver provides guidance to the front wheels, and a Novak* NER 3 FM receiver picks up the signals generated by my trusty JR* 756 transmitter. A Pure-Tech* 6-cell, LTO-style battery strap keeps the pack right where it belongs if the car flips, but Cobra also makes a battery strap (no. 71087) that would work well.

PERFORMANCE

You have to learn how to drive a sprint car, because it has to slide to be fast. It takes a while to get the hang of it, but beware: sprint cars can become addictive! There's something about hanging the back end out and countersteering the front end through a turn (like when your full-size car slips sideways in the snow) that makes you want to do it more and more. Based on the reaction of the many people who've seen me test this car, I'm looking forward to being able to race with a lot of folks come springtime!

FINAL THOUGHTS

For those of you who want to try out a sprint car but don't want to invest a lot of cash, Cobra also makes a sport version of the Nemesis. It uses most of

the same parts, but it has a fiberglass chassis instead of the graphite chassis and upper deck, and Oilite bushings instead of ball bearings. Its list price is \$175 less than that of the pro-level car.

If you're ready to get really crazy, a fellow called "The Wiz" at Quarter Flash* tells me that their upper wing kit and offset kit (with shorter left-side and longer right-side arms and dogbones) will be available in a couple of months.

As I was driving home the other evening, I mentioned to my wife that I was having an awful lot of fun with the Nemesis. Her reply? "I know; you've been playing with that car and taking it apart and putting it back together again ever since you got it. You haven't done that in years." Did someone say that sprint-car racing could become addictive?

*Addresses are listed alphabetically in the Index of Manufacturers on page 184.

TEKIN

INSIDE NEWS

POWER-FLEX

People sometimes wonder about the Power-Flex operation. Briefly; during normal use, gas by-products in sealed cells form chemically impure deposits on the internal electrode plates of nickel-cadmium cells. These impurities build up which reduces the active surface area of the cell, "clogging up" the electron flow. The result is a cell that tests with up to 20% higher cell resistance, and reduced voltage under heavy amp load.

Tekin's Power-Flex process uses precision timed and controlled reverse current pulses which electrically wash away impurities from the electrode plates as you charge. This creates more active surface area, allowing a greater current flow path, and less voltage drop. It is like switching to a 1-2 turn hotter motor. Through this process, cells also last longer, and charge and run cooler. We think it works quite well.

One of the nicest things about the Power-Flex chargers are all the display screens. You get volts, amps, time, amp-hours, trickle adjust, volts peak, time charge, current adjust, 3 charge modes, and other display items. These are easily used by pressing the up and down controls on the front panel. Whatever your charging style, drive on!



Other Charger Terminology

A DC charger is one that runs off a 12-14 volt power supply, or automotive battery. An AC/DC unit will also run off the wall. **PEAK DETECTOR** chargers automatically shut off when the battery voltage reaches its highest. **PULSE** chargers work by cycling the charge current on and off rapidly. This is a practical way to regulate the charge current. **LINEAR** charging has a constant smooth flow of current into the cells at all times, so it is very easy on the cells. **POWER-FLEX** charging is similar to LINEAR charging, but with occasional **NEGATIVE CURRENT** pulses, to purge the cell of excess internal gas.

TEKIN ELECTRONICS

940 CALLE NEGOCIO

SAN CLEMENTE, CA 92673



Performance



on



TRAXXAS Rustler

by GEORGE GONZALEZ

TRAXXAS* IS WELL-KNOWN for producing high-quality vehicles at very competitive prices. Well, if you're interested in getting a stadium-truck ride without spending a ton of money, it looks as if Traxxas may have the answer to all your truckin' needs. Their newest 1/10-scale entry-level truck—the Rustler—is the least expensive stadium truck on the market, yet it's packed with racing features that make it a very competitive racing machine. Let's take a look.

KIT FEATURES

The Rustler's chassis is molded out of a new, fiber-composite material that's extremely rigid and tough. Its reinforced-tub design and molded upper plate also prevent the chassis from flexing. The position of the batteries means a low center of gravity, and that means stability and fewer tip-overs. The chassis also has 30-degree front rake to increase stability under all conditions.

A racing-style steering bellcrank, which is mounted on the upper chassis plate, faithfully performs the steering chores. The steering bellcrank system pivots on aluminum posts that are supported by plastic bushings, which could easily be upgraded with bearings. Overall, the system is super-smooth and super-tight, and you won't notice any bump-steer.

On all four corners are extra-long A-arms with molded upper links, and they look beefy enough to withstand serious abuse. The molded, oil-filled, coil-over shocks feature double O-rings and plastic seals for leak-free operation, and the shock caps include rubber diaphragms to prevent oil foaming. A set of quick-release spring collars allows accurate, hassle-free spring-rate adjustment without any risk of over-tightening them (which could cause binding and premature wear). The kit also includes several different shock pistons for even more "tunability."

The Rustler's unique, centered-kingpin, live-axle suspension is really hot. The front axles have drive pins that are mated with the front wheels; this forces the axles to rotate inside the wheel bushings instead of making the wheel bushings rotate around the axles. According to Traxxas, the live axles improve the truck's cornering while reducing wheel "chatter."

a shoestring

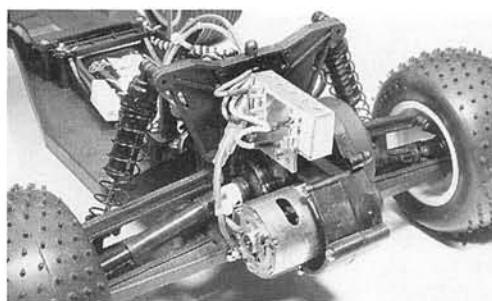
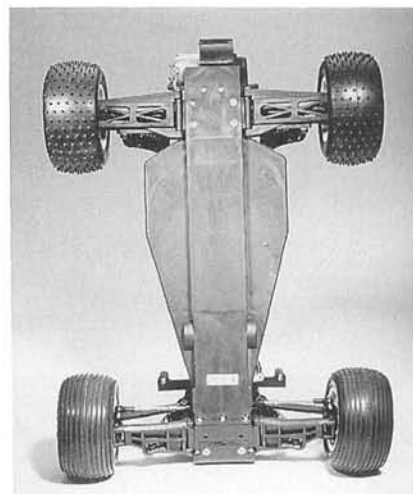
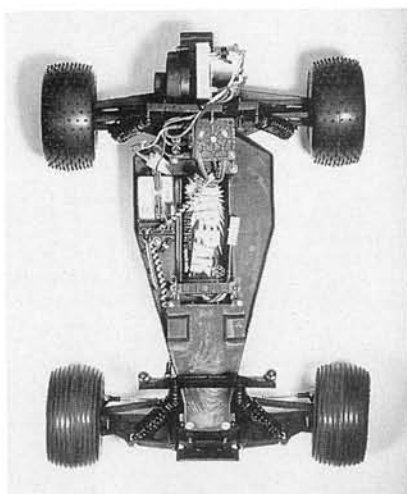
BUILDING AND SETUP TIPS

The Rustler is definitely one of the most builder-friendly racing trucks on the market. Much of this is because of the excellent instruction manual and perfectly fitting parts. If you've never built an R/C vehicle, I suggest that you order a pizza, crank up some tunes, and make a party of it. I had my Rustler up and running in less than three hours, and didn't run into any problems along the way.

The best advice I can pass along is: before you start, read the instruction manual to become familiar with all the truck's major components; don't open any parts bags until the parts are called for in the manual; and don't take shortcuts (like not reading the instructions). Other than that, just have fun.

Things you'll need:

- 6-cell battery pack
- Battery charger
- 2-channel radio system with two servos



Above: the Traxxas chassis features a low-center-of-gravity design that resembles Losi's G-Tunnel chassis. The low CG makes the truck more stable over the rough stuff.

A stock 540 motor comes with the Rustler. Extra-long A-arms both front and rear ensure a smooth ride, and they're beefy enough to take a beating.

Factory Options

- A full set of ball bearings will greatly enhance performance and reliability.
- To increase the truck's cornering capability, Traxxas offers a dual-ball-bearing ball diff with carbide balls.
- Installing a slipper clutch will prolong the life of the tranny's internal gears and provide traction control on slippery surfaces.
- Adding a complete set of adjustable upper links will allow you to adjust the camber to suit any track conditions.

The Rustler's transmission uses a race-proven, 3-gear setup with a super-low 2.72:1 gear-reduction ratio. A bulletproof planetary-gear diff with steel gears is standard. There's also an optional ball diff that will considerably improve the truck's handling. Unfortunately, the kit doesn't include a slipper clutch, but it's on the list of hop-ups. I highly recommend this upgrade because it will markedly prolong the life of the internal gears.

The Rustler includes a set of hot-looking wheels that are deeply offset to allow the front steering blocks and rear axle carriers to be mounted deep inside the wheels. This allows the use of extra long A-arms, and that increases suspension travel while the inboard pivot points dramatically reduce wheel scrub. The kit also includes a set of Pro-Trax multi-rib front tires and a set of Pro-Trax seven-row spiked tires for the rear (this tire combination seems to work best on loose, fluffy dirt).

Specifications

Scale 1/10
List price.....\$150

DIMENSIONS

Overall length.....17.75 in.
Wheelbase.....12.50 in.
Front width.....13 in.
Rear width.....13.50 in.

WEIGHT

(gross, RTR)4 lb., 5 oz.

CHASSIS

Type.....Molded tub with upper brace
Material.....Fiber-composite nylon

DRIVE TRAIN

TypeSealed gear drive
Primary.....Pinion/spur
Transmission..... 3-gear with 2.72 gear reduction
DifferentialMetal planetary gear
Slipper clutchNo
Bearings/bushings.....Oilite bushings

SUSPENSION (F/R)

Type.....Lower A-arm with molded upper link
DampingOil-filled, coil-over, molded shocks

WHEELS (F/R)

TypeOne-piece nylon
Dimensions (DxW)22x2 in.

TIRES

FrontMulti-rib
Rear.....Seven-row spiked

ELECTRICS

Motor.....Stock 540, closed endbell
Battery6-cell stick pack (not included)
Speed control...Mechanical 3-speed with 3-speed reverse

THE COMPETITION

	Rustler	Junior-T*	RC10ST	Club 10 Storm	MT 10S
Wheelbase (in.)	12.5	11.25	11.375	12.90	13.00
Width (in.)	13.00	12.00	12.50	12.04	13.00
Weight	4 lb., 5 oz.	3 lb., 15 oz.	3lb., 15.40 oz.	3 lb., 7.58 oz.	4 lb., 2 oz.
Diff type	Planetary gear	Ball	Ball	Ball	Ball
Chassis	Composite nylon	Composite plastic	Aluminum	Composite plastic	Composite plastic
List price	\$150	\$139.95	\$240	\$189.50	N/A
Available at**	\$89.99	\$74.99	\$119.99	\$110	\$110
Issue reviewed	5/95	12/91	3/95	TC	4/95

*Motor and speed control not included; **Prices will vary with location.

likes

- Extremely low price (least expensive racing truck on the market).
- Excellent handling, even in stock trim.
- Easy to build (perfect for beginners).
- Great-looking Lexan body with wing.
- Super-smooth steering-bellcrank system (can be upgraded with bearings).
- Extremely durable chassis and suspension components.
- Impressive list of hop-ups.

dislikes

- Ball diff and slipper clutch not included.
- Molded upper links prevent camber from being adjusted.
- The molded motor mount doesn't dissipate heat very well.

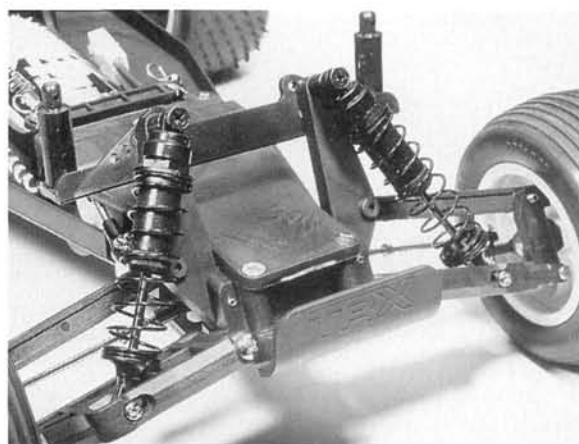
Rounding off the list of hot features are: a mechanical speed control with reverse; a hot-looking stadium-truck body; and a really cool set of decals. The mechanical speed control works incredibly smoothly and has proven to be extremely reliable. The Lexan body is a real showstopper and has received more compliments than all my other truck bodies combined. I painted the body according to Traxxas' recommendations: Pactra* Racing Red, Royal Blue, Sprint White and Outlaw Black (looks great!).

TEST GEAR

Traxxas was kind enough to supply me with all the necessary radio gear. A Traxxas 2020 transmitter sends the commands to a 2-channel, 27MHz receiver. The signal is then picked up by a pair of 2018 servos (one for steering and one for throttle). A Trinity 6-cell Zip Pack provides the power, while a mechanical speed control with reverse transfers the power to the supplied 540 stock motor.

PERFORMANCE

I headed out to the Ranch Pit Stop in Pomona, CA. It was race day, so the track was crowded, and I found myself testing the Rustler under the most adverse conditions. It was bone stock,



The front end features a 30-degree front-rake kick-up that ensures a stable ride in all types of conditions. Though most racers frown on plastic shocks, the units performed well and proved themselves out on the track.

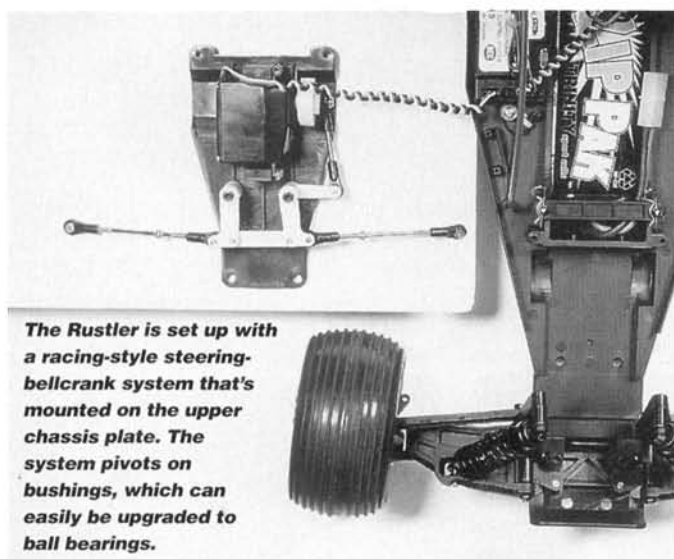
PHOTOS BY WALTER SIDAS

so it was considerably slower than the rest of the cars and trucks, but I managed to hold a consistent line and never once flipped over. The truck handled extremely well, and I actually think I could have made the A-main by installing a budget electronic speed control, a competition stock motor and some mini-pin rear tires. Unfortunately, I didn't have the time to make these mods at the track, but I'm confident that this truck would have held its own.

FINAL THOUGHTS

If you're thinking of getting started in R/C, I strongly recommend that you consider the Traxxas Rustler. Don't let its low price fool you; it's extremely durable and it handles really well. Right out of the box, it's perfect for bashing around your neighborhood, and with a few hop-ups, it could hold its own on any track. Remember, it's not how much you spend, it's how well you drive, and the Traxxas Rustler is a world-class trainer.

*Addresses are listed alphabetically in the Index of Manufacturers on page 184.



The Rustler is set up with a racing-style steering-bellcrank system that's mounted on the upper chassis plate. The system pivots on bushings, which can easily be upgraded to ball bearings.

CAR ACTION'S 1995

Top 10

TO GET into *Car Action's* Top 10 list is an amazing achievement—no ifs, ands, or buts about it. As you know, there's a ton of really noteworthy vehicles and accessories out there.

This year, we really had to rack our brains (and it hurt!). We had meeting after meeting about who offers what and what should go where and why, and we eventually agreed that there would be just two categories—Top 10 Cars and Top 10 Accessories. In past years, we had categories for just about everything under the sun, but we wanted to narrow it down this time. It wasn't easy, though. After careful deliberation, we've chosen these cars and items as being among the best in the industry this year. Read on....

For your convenience, the addresses of the companies featured here are listed alphabetically in the Index of Manufacturers (for page number, see "Contents").

by John Howell and John Huber

cars

SCALE 1/10 (approx.)
PRICE \$89.95 (w/out electrics)
\$129.95 (w/electrics)

DIMENSIONS

Overall length 14 in.
Wheelbase 9.3 in.
Front track 7.75 in.
Rear track 8.40 in.

WEIGHT (gross, ready to run) 2 lb., 6 oz.

DRIVE TRAIN

Type Direct
Primary Pinion/spur
Transmission Direct
Differential Rear ball diff
Slipper clutch No
Bearings/bushings Bushings

SUSPENSION (front only)

Type Kingpin
Damping Silicone

The Bolink Legend is one crazy car. Not only is it extremely cheap (we're talking in the vicinity of \$60 through mail order), but it's fun to drive. We started our own little race club here at *Car Action* using the Bolink Legend, and we're having a blast; this car is about back-to-basics R/C racing—that's right! CCR (cost-controlled racing). Slap in an inexpensive battery and ESC and motor combination, and you have a low-buck racecar that you and your friends can all enjoy running against one another.

The car's design is very straightforward: two side rails of black fiberglass join a narrow, central, chassis piece to form the backbone of the car. A direct-drive axle with a ball diff gets things rolling, while a kingpin with a coil-spring-suspension setup absorbs the bumps up front. Though the car doesn't have rear suspension, it really doesn't need it; it's such a blast to drive that you'll quickly forget it's not a high-buck racecar. Top it off with Bolink's cool-looking Legend body, and get out there and start tearing up the local parking lots.

Bolink LEGEND



Top 10 cars

When it comes to 1/10-scale, stadium racing trucks, Team Losi's newest entry—the Double-XT—is one of the most technologically advanced on the market. The Double-XT is based on its buggy brother's modular design. By removing a few screws, you can separate just the tranny or the entire rear end from the rest of the chassis. Up front, remove a few screws, and you can easily access the steering bellcrank system and steering servo via a swing-away front-end design that's just like the one on the buggy.

Other hot features include: the Losi-G tunnel chassis, which is made of a stiff composite material known as "Stiffezell"; a compact 3-gear Double-X transmission; stiff, ultra-long suspension arms, which are made of the same material as the chassis; and Gold-compound step-pin rear tires and HT ribbed front tires.

As of this writing, Team Losi has now set the standard for up-and-coming race trucks; the Double-XT is out on the tracks and winning races and national titles already.

Team Losi DOUBLE-XT



SCALE 1/10
LIST PRICE \$339.95

DIMENSIONS

Overall length 15.5 in.
Wheelbase 11 in.
Front width 12 in.
Rear width 12.6 in.

WEIGHT (gross, ready to run) 4 lb., 2 oz.

DRIVE TRAIN

Type Sealed gear drive (2.61:1 reduction)
Primary Pinion/spur (88-tooth spur inc.)
Transmission 3-gear Double-X tranny
Differential Racing ball diff
Slipper clutch Friction w/Hydra Drive
Bearings/bushings Sealed ball bearings

SUSPENSION (F/R)

Type Independent A-arm w/adjustable
camber link
Damping Oil-filled, coil-over shocks

Parking-lot racing is hot these days, and more and more manufacturers are developing some serious on-road weaponry for this class. Well, Kyosho's newest entry in this "fun" yet competitive category is their new Impress F1 car.

The car has a lower fiberglass chassis and an upper plastic brace. The rear pod is completely boxed in like a pan car's, but the motor is easily accessible. Unlike what you find on other F1 cars, the puck/damper assembly is directly in front of the rear pod, not in front of a T-bar assembly. Also, with the damper-plate system, this car uses a spring post that helps with the front- and rear-suspension movement. This rear-suspension setup results in much more consistent handling.

The Impress's front suspension consists of an upper arm and a lower arm on each side. At the end of each lower arm is a small plate that controls negative camber. Two- and 4-degree plates come with the kit. Increasing camber makes the car turn more quickly.

Check out the reactive-caster front-suspension system. The suspension pivot balls are mounted at different heights in the front and the rear, so when the suspension is compressed, caster is reduced.

Since the car was designed as a full-blown racecar, Kyosho did not include a body, a motor, or a speed control; those decisions were left to drivers' individual tastes.



Kyosho IMPRESS

SCALE 1/10
LIST PRICE \$199

DIMENSIONS

Overall length 15.2 in.
Wheelbase 9.8 in.
Width (F/R) 7.9 in.

WEIGHT (gross w/battery) 2 lb., 2 oz.

DRIVE TRAIN

Type Direct drive
Primary Pinion/spur
Transmission None
Differential(s) Ball
Slipper clutch None
Bearings/bushings Bearings

SUSPENSION

Front Reactive caster
Damping None
Rear T-bar/flex plate,
damper disk and plate damper
Damping Spring rod

SCALE 1/10
LIST PRICE \$269 (w/out body)
\$310 (w/body)

DIMENSIONS

Overall length 14 in.
Wheelbase 10.25 in.
Width (F/R) 7.13 in.

WEIGHT (gross w/batteries, etc.) 3 lb., 3 oz.

DRIVE TRAIN

Primary Spur/pinion
Transmission Belt drive
Differential(s) Ball diffs
Slipper clutch None
Bearings/bushings Bearings

SUSPENSION (F/R)

Type Lower A-arms with upper control links
Damping Oil-filled, coil-over shocks

The Yokomo YR-4 may, in fact, be the king of the high-end, all-out-racing, 1/10-scale, parking-lot sedans. It has a fiberglass chassis with an upper fiberglass stiffener, two ball diffs, 4W independent suspension (which uses aluminum-body, coil-over, oil-filled shocks) and a belt-driven 4WD system. The car's belt-driven drive train is roughly based on the one used in the winning '93 Super Dogfighter off-road buggy, which has proven to be extremely reliable. This car has been tearing up parking-lot tracks on the West Coast and is quickly becoming a favorite ride of parking-lot fanatics.

Yokomo YR-4



Team Associated RC10GT

The hottest category in gas racing right now is 1/10-scale nitro trucks, and Team Associated's RC10GT is one of the hottest trucks out there. The RC10GT combines the features of Associated's winning electric truck—the RC10T—with the power of nitro.

The truck features an aluminum, stamped-tub chassis, which looks similar to its electric brother's chassis but is narrower on one side. The GT uses similar suspension components to those on the electric RC10T—components

such as long front and rear composite suspension arms, hard-anodized Teflon-coated Team shocks and one-piece wheels.

Other features include a newly designed Stealth tranny for the GT, a new steering bellcrank system (provides excellent steering response), a fuel tank (with an internal filter) and a disk-brake system.

An optional kit from Associated includes a clutch setup, a tuned pipe, engine mounts (for pull- or non-pull-start engines) and an RC10GT setup and tuning video.

SCALE 1/10
LIST PRICE \$445

DIMENSIONS
Overall length 16 in.
Wheelbase 11.1 in.
Width (F/R) 12.25 in.

WEIGHT (gross, RTR, w/out fuel) 4 lb., 0.03 oz.

DRIVE TRAIN
Type Gear
Primary Pinion/spur
Transmission Gear
Differential(s) Ball
Slipper clutch Friction type
Bearings/bushings Ball bearings

SUSPENSION
Type (F/R) 4W independent w/adjustable upper link
Damping Oil-filled, coil-over shocks



At a glance, Team Associated's newest off-road venture, the Worlds Car, looks almost identical to its predecessor, the Team Car, but further inspection reveals that it's an entirely new machine. Though it has some of the features found on the Team Car, there are a lot of differences between the siblings.

The new Worlds Car chassis has been stamped out of a stronger grade of aluminum and has been milled out in the bottom and the nose piece to save weight.

Major changes in the suspension department include new, black-composite suspension arms, which are stronger than their predecessors, as are the new front and rear graphite-laminated fiberglass shock towers. New Teflon shock seals ensure a more precise fit within the shock body, and a new rear bulkhead has been molded to match the height of the transmission, so you don't have to use spacers to make it fit properly. A few additional camber-rod holes have been made in the bulkhead to increase tuning versatility.

The 3-gear Stealth tranny has been revamped only slightly, while Associated's traction-control, slipper friction clutch has received a new solid bushing in place of the old bearing to help increase off-the-line acceleration.

Other features include a new bellcrank steering system, Pro-Line XT and XTR tires, new wheels, an RCPS Turbo Mirage body, 30-degree caster blocks and a graphite tranny brace.



Team Associated WORLDS CAR

SCALE 1/10
LIST PRICE \$337

DIMENSIONS
Overall length 15.25 in.
Wheelbase 10.5 in.
Width (F/R) 9.625 in.

WEIGHT (gross, RTR) 3 lb., 10 oz.

DRIVE TRAIN
Primary Pinion/spur
Transmission Gear
Differential(s) Ball diff
Slipper clutch Friction slipper
Bearings/bushings Bearings
Drive shafts Universal joint

SUSPENSION (F/R)
Type Independent A-arm w/upper, adjustable camber link
Damping Oil-filled, coil-over shocks w/hard-anodized bodies

SCALE 1/10
LIST PRICE \$100—Model 3601 (kit)
\$175—Model 3610 (RTR)

DIMENSIONS
Overall length 16.75 in.
Wheelbase 11 in.
Front track 10.25 in.
Rear track 10 in.

WEIGHT (gross, RTR) 4 lb., 8 oz.

DRIVE TRAIN
Type Gear
Primary Pinion/spur
Transmission 3-Gear
Differential(s) Planetary gear
Slipper clutch None
Bearings/bushings Oilite bushings

SUSPENSION (F/R)
Type Molded upper links, lower A-arms
Damping Molded, oil-filled, coil-over shocks

Traxxas STAMPEDE

The all-new Traxxas Stampede is one tough monster truck. Not only is it tough, but it's cheap, too! Looking through any mail-order section, you'll quickly find this

truck at right around \$100. Don't let that inexpensive price tag fool you, though; this truck is made to last. The truck features a narrow, fiber-composite tub chassis that sits high above the front bulkhead and rear transmission and has 4 inches of ground clearance. The tranny and the front bulkhead are supported by a molded, lower cross-brace that doubles as skid plates.

Extra-long suspension arms made of extremely rigid composite materials absorb punishment from all angles, while extra-long, molded, coil-over shocks absorb all the bumps and jumps.

The truck's tranny is based on the race-proven Magnum 272 tranny, which is found in Traxxas's full-blown racing truck, the SRT. The transmission incorporates a smooth, bulletproof, gear differential.

Also included are a plastic slider-shaft drive system, 2.2-inch wheels (with aggressive-tread tires) and a sharp-looking '95 Dodge Ram-style pickup truck body.

The Stampede is available both as a kit and ready to run (RTR).



Tamiya TA02 CHASSIS



Tamiya's versatile, 4WD, TA02 chassis is used both on-road and off-road. In on-road format, it's the backbone of a number of Tamiya's stunning parking-lot racer sedans. When it's time to go off-road, you can find the same chassis doing double duty underneath either an accurately detailed Toyota Prunner, Chevy S-10, or rally-car body.

The TA02 is a durable, injection-molded ABS plastic, bathtub-type chassis that has proven to be very sturdy and reliable. The chassis is equipped with: a propeller-type shaft-drive system; two differentials; a ball diff for the rear gearbox, and a gear diff for the front; 4W independent suspension; oil-filled, coil-over, plastic shocks; a 540 motor; and a 3-step mechanical speed control. Depending on which type of vehicle you've purchased, you also get a really trick-looking body and decals as well as a highly detailed set of on- or off-road wheels and tires.

SCALE.....1/10
LIST PRICE\$268

DIMENSIONS
Overall length.....18 in.
Wheelbase.....10.1 in.
Width (F/R).....7 in.

WEIGHT (gross, w/battery).....3 lb., 2 oz.



DRIVE TRAIN
Type.....Gear
Primary.....Pinion/spur
Transmission.....Gear
Differential(s).....Ball/bevel gear
Slipper clutch.....None
Bearings/bushings.....Metal and plastic bearings

SUSPENSION (F/R)
Type.....4W independent w/fixed upper link
Damping.....Oil-filled coil-over shocks

Team Losi DOUBLE-X

SCALE.....1/10
LIST PRICE\$339.95

DIMENSIONS
Overall length.....15 in.
Wheelbase.....10.625 in.
Front width.....9.625 in.
Rear width.....9.875 in.

WEIGHT (gross w/batteries).....3 lb., 8.5 oz.

DRIVE TRAIN
Type.....Sealed gear drive (2.19:1 reduction)
Primary.....Pinion/spur (88-tooth spur incl.)
Transmission.....Universal-joint/dogbones
Differential(s).....Racing ball diff
Slipper clutch.....Friction w/Hydra Drive
Bearings/bushings.....Sealed ball bearings

SUSPENSION (F/R)
Type.....Independent A-arm w/adjustable
camber link
Damping.....Oil-filled, coil-over shocks

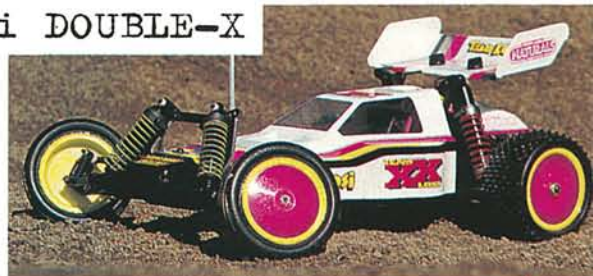
Since the Double-X was introduced, it has won races all over. It was top qualifier at the '93 IFMAR Off-Road World Championships and, most recently, it took top honors at the '94 ROAR Off-Road Modified Nats.

The buggy features a modular design. The entire rear-end assembly can easily be removed from the chassis by taking out a few screws. The same can be said for the tranny: take out four screws, and it pops right out.

The front end has the same easy-access feature as the rear end. Remove a few screws to gain access to the swing-away-style front end, and you can easily get to the steering servo and the steering bellcrank system.

Losi's low-center-of-gravity, G-Tunnel chassis and long suspension arms are made out of a composite material known as "Stiffezell," which is extremely strong and light. The car comes with Losi's newest tranny design, the Double-X tranny, which is one of the smoothest and most efficient on the market.

Its other features include: a unique servo-saver setup (which has been incorporated into the steering bellcrank system) and an interesting universal servo-mounting setup (which gives you an assortment of servo horns and arms, and when mounted, stays put for good). Gold-compound tires get plenty of bite on almost all types of track.



Trinity STREET SPEC PARKING LOT RACER

Trinity is trying to get competitive racing back into the realm of everyday R/C enthusiasts.

Their Street Spec Parking Lot Racer isn't exactly the most high-tech R/C car on the planet, but it serves a purpose, and it serves it well. This car makes inexpensive R/C car racing available to everyone, and it's not only this car that's making the list, but the entire Street Spec principle that lies behind it. Inside the Trinity S-Spec 10 box, you'll not only find the basic car kit, but you'll find a Spec motor and battery and even a NASCAR or touring sedan body as well.

The car has a basic pan-car design, yet it still gives you the thrill of competitive racing. It has a G-10 fiberglass chassis, which features a sliding-pillar-type front suspension and a conventional motor pod with T-bar rear suspension. Other features include: bushings for the front wheels and the rear hub; a Magic Motorsports spur gear; an aluminum motor mount; and Spec foam tires—one of the car's hottest features. Tires tend to be very expensive, but these list for only \$9.99 a pair. The kit itself, which is listed at \$199.95, should hit the hobby shop shelves in your area at anywhere from \$160 to \$179.



SCALE.....1/10
PRICE\$199.95

DIMENSIONS
Overall length.....13.5 in.
Wheelbase.....10.5 in.
Front width.....7.25 in.
Rear width.....8.25 in.

WEIGHT (gross, ready to run).....2 lb., 10 oz.

DRIVE TRAIN
Type.....Direct drive gear
Primary.....Pinion/Spur
Differential.....Ball type
Slipper clutch.....None
Bearings/bushings.....Both

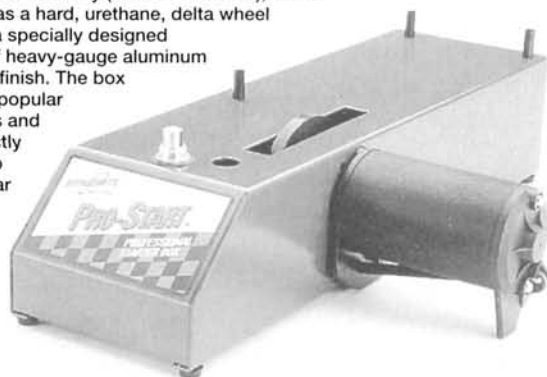
SUSPENSION
Front: type.....Floating kingpin
Rear: type.....T-Bar
Damping (F/R).....Lube on kingpin/
damper washers

Top 10

accessories

Dynamite Pro-Start Starter Box

Start your nitro-powered R/C buggy or truck much more easily with a starter box. If your gas car has an engine that's mounted laterally (from side to side), check out this starter box from Dynamite. It has a hard, urethane, delta wheel and a powerful 12V starter motor with a specially designed spring/switch. The box itself is made of heavy-gauge aluminum and has a durable, red-powder-coated finish. The box comes with a template for all the most popular 1/10-scale gas trucks, 1/10-scale pan cars and 1/8-scale gas cars. This shows you exactly where to set up your alignment pegs so that you'll be able to hold your particular car securely on top of the box lid while you try to start the engine.



Airtronics Caliber Radio

The Airtronics Caliber is one of the most popular racing FM radio systems on the market. The company's newest radio—the 3Ps—is cosmetically the same as the old Caliber but, inside, it's very different. Compared with its predecessor, it features a 400-percent-faster processing speed, and that translates into increased responsiveness. Also, the radio's programming has been simplified. Instead of having six setup buttons to deal with, there are now only four. Current drain has been improved, too. The old Caliber was somewhat hard on batteries; this one is not. An LCD display gives all the pertinent information.



Tamiya Aluminum Rims

If you have a 4WD or a front-wheel-drive Tamiya sedan, you just might want a set of these aluminum rims. One style has the six spokes you see on European sports cars; the other is the traditional BBS mesh wheel. Both feature a finish that makes them look incredibly like the full-size version. The dull gray center spokes have a "glass-bead" look, while the outer rim has been machined to a brilliant shine. These rims might not be the best thing for bashing around in your backyard, but they will add the finishing touch to any concours contestant.



Kyosho Steering Gyro

A lot of people have trouble keeping their car pointed in the right direction. It's very difficult to know when the rear end of your car is starting to slide, because you aren't in the car to feel it. Well, Kyosho has taken some technology from the helicopter segment of the hobby and placed it on four wheels; enter...the Steering Gyro.

Connect it between the steering servo and your receiver, and mount it on your chassis with foam tape. Once adjusted, the Gyro will sense any rear-end sliding and will counter the steering proportionally. The Gyro uses the latest piezo-electric technology to make a unit with no moving parts. And you can tune the unit's sensitivity and reaction to suit your particular application.



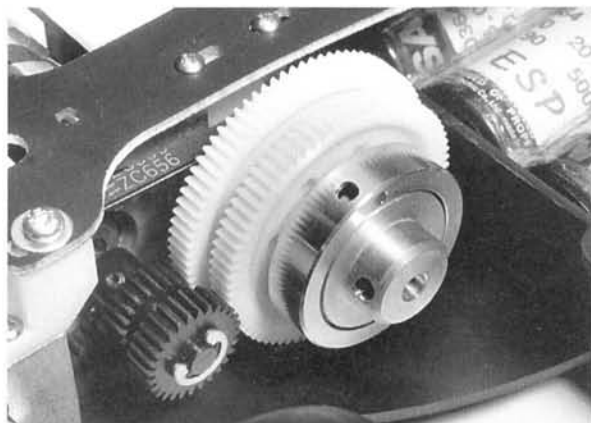
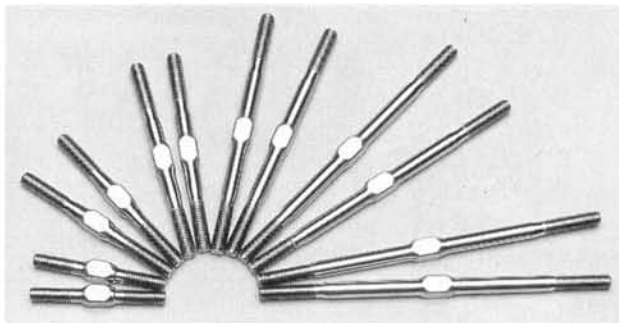
Pro-Line Road Hawks

Have you ever wanted to take your off-road buggy or truck on-road racing? If you have, you might want to check this out. Pro-Line's Road Hawk tires allow you to race on-road with serious grip. Made of Pro-Line's super-sticky XTR compound, the directional-pattern Hawks come in four sizes. For stadium trucks, a 2.2-inch-wide tire fits both front and rear wheels; 2WD buggies get a 2-inch rear; and Pro-Line's medium-wide fronts get the 2-inch size. For 1/10-scale on-road cars, use 2-inch-wide Road Hawks and Pro-Line wheels front and rear; and they've just released a set for sedan touring cars.



Lunsford Punisher Titanium Turnbuckles

One of the first mods a racer makes to his new racing buggy or truck is to add a set of titanium turnbuckles. Titanium turnbuckles are approximately one-third the weight of a comparable steel unit, yet they're roughly three times as strong. Well, if you're in the market for a new set of titanium turnbuckles, Kelly Lunsford's Punisher Series has turnbuckles in just about any length you're ever likely to need. Kelly also offers a handy little titanium turnbuckle wrench.

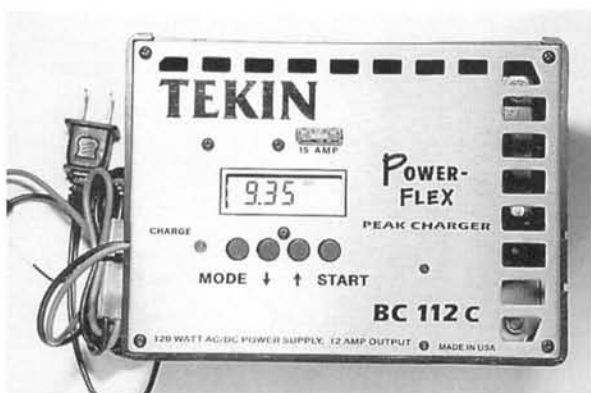
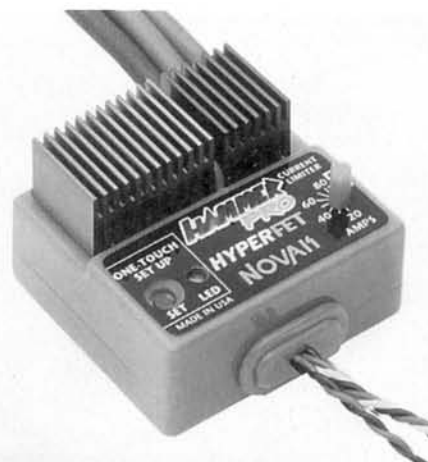


Yokomo 2-Speed Transmission

Yokomo has released a "secret weapon" in the form of a 2-speed transmission for their electric touring car, the YR-4. This simple, efficient, self-contained unit has a centrifugal clutch, and it allows you to strap in some *major* horsepower. It's a real thrill to watch a YR-4 attacking a straightaway: hear it whine and then squat down as it shifts into second gear. With this tranny, you really don't have to worry about smokin' your motor with tall gearing anymore.

Novak Hammer Pro

The Novak Hammer Pro is Novak's first full-blown racing-style ESC with their One-Touch Setup™ and HyperFET transistors. The Hammer Pro, which is based on Novak's Nationals and IFMAR title-winning ESC—the 410 HPC—is equipped with CLC II current-limiting circuitry, which provides smooth acceleration and can be turned off when you need maximum throttle response. Its other features include: Radio Priority Circuitry, which routes servo power to the steering servo until the battery has completely dumped; digital glitch prevention; Micro-Fin purple heat sinks; 120 amps of braking power; and 12-gauge wires.

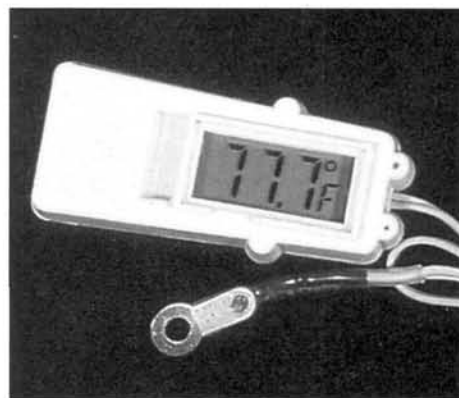


Tekin BC 112C

Everyone who's into electrics needs a charger. The Tekin BC 112C is the most advanced charger you can get that plugs into a wall. The BC 112C can charge anywhere from one to 12 cells, and it features a Power-Flex battery conditioner circuit that lowers the internal resistance of your Ni-Cds to increase current flow and voltage under heavy load—added punch! The Power-Flex circuit also erases cell memory and increases cell life by up to three times. Its other hot features include the capability to run on AC or DC power; it's expandable, so it can be used with a discharger/cycler; it has linear current-output control; and it has three built-in charging profiles (peak mode, re-peak mode and a cold-start mode).

MIP Temperature Gauge

If gas engines get too hot, they self-destruct in a relatively short time. It's therefore crucial that you keep your engine running in its optimum temperature range (between approximately 220 and 250 degrees Fahrenheit). So how do you know when your engine is at that temperature? Well, there's the trusty spit-on-the-cylinder-head test, which is about as accurate as timing the 100-meter dash with a sand dial, or you could invest in a temperature gun, which accurately tells you the engine's temp. The only drawback to buying a temp gun is that they're somewhat expensive. Luckily for us, MIP now makes an inexpensive (\$50) temp-reading unit that can be bolted right onto the base of the cylinder head. It's very accurate, and it's constantly reading engine temp; just pull your truck up next to you, glance down, make adjustments if you need to, and you're off and running again.



The addresses of the companies featured here are listed alphabetically in the Index of Manufacturers on page 184.

Everything You Wanted to Know About ESCs

by Stan Van Druff and RCCA staff

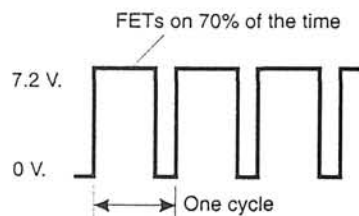
WHAT IS AN ESC?

ESCs do away with the servo and are connected directly to the receiver just as a servo would be. Instead of using power-robbing resistors, ESCs control a motor's speed with transistors that interrupt the flow of current to the motor. With low-frequency controllers, these interruptions happen about 60 times per second; and with high-frequency controllers, at about 2,500 times per second.

The transistors use pulse-width modulation (PWM) to turn the voltage on and off (see Figure 1). ESCs vary the speed of a motor by adjusting the percentage of time the voltage is reaching it. If the voltage is on for 70 percent of the time, for example, the motor will run at 70 percent of full speed. PWM controllers are very efficient and can be made very small.



Figure 1.
PWM speed control.



YOU'D NEVER want to drive a car that doesn't have a throttle and brakes that operate smoothly. On R/C electric cars, speed controls—inexpensive mechanical ones, or more flexible electronic controls (ESCs)—provide both functions. Entry-level cars often come with mechanical units, but an ESC is lighter and more efficient than a mechanical controller and its required servo. ESCs also accelerate motors faster, produce less heat and usually last longer than mechanical controllers; they give you smoother control by providing "stepless" speeds. Some will help you to control wheelspin, and others will even recharge your batteries when you use the brakes.

LOW- AND HIGH-FREQUENCY ESCs

LOW-FREQUENCY ESCs were developed first, and they're cheap. They operate at 60Hz (cycles per second) and use the inexpensive timing circuits used in millions of servos. Unfortunately, low-frequency controllers make the motor run roughly at low speeds, and they waste more power than high-frequency ESCs. Because they're less efficient, they give shorter run times and get hotter than high-frequency models.

HIGH-FREQUENCY ESCs operate at between 2000 and 3000Hz. They use custom-built circuits; some high-end models use microprocessors to control timing, current limiting and even automatic

calibration. High-frequency controllers run cool and give very smooth control, even at the lowest of speeds. Their only drawback is that, if they aren't properly installed, they can interfere with the radio.

So which should you choose? It's basically a question of cost versus efficiency. High-frequency models (2500Hz) are so much more efficient than low-frequency ESCs that most racers are happy to pay the extra bucks for them. Modified motors put such a strain on batteries that nearly all modified racers have switched to high-frequency controllers. They're also useful in stock-class racing, and they extend run time, even for backyard drivers.

◀ Cycle repeats 60 times per second for standard controllers, 2,000 to 3,000 times per second for high-frequency controllers. When FETs are on 70% of the time, the effective voltage going to the motor is 70% of 7.2 volts—5 volts.



FORWARD/REVERSE ESCs

FORWARD AND

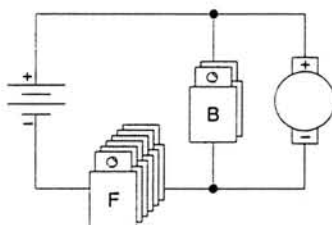
ESCs come in forward-only and forward/reverse models; all have brakes. When driving for fun, I can't live without reverse. But for racing, a forward-only controller is the way to go. It seems that every time someone used reverse on a racetrack, he backed out in front of someone else! Officials realized that the only way to prevent that was to prohibit racers from using reverse. You may not know that forward-only controllers are faster than their forward/reverse brothers.

- Forward-only controllers are pretty easy to understand (see Figure 2). Their FETs are arranged in two groups (see "What is a FET" sidebar). The forward group (F)—usually five or six FETs—is installed between the battery and the motor to provide forward voltage for it.

These FETs are wired in parallel (side by side) and act just as if they were one big FET. The brake group (B)—usually one or two FETs—provides braking by short-circuiting the motor.

Controllers use many FETs in parallel to drop resistance and increase current capacity. A typical FET has a resistance of approximately 0.0125 ohm and can carry 50 amps (continuous). The total resistance of the FETs is the resistance of one FET divided by the number of FETs wired in parallel. Total current capacity is the capacity of one FET multiplied by the number of FETs wired in parallel. So a

Figure 2.
Forward only ESC.



Forward-only controllers use six FETs in parallel for forward with two in parallel for brakes. When all the FETs marked "F" are turned on, the motor runs forward; when all the FETs marked "B" are turned on, brakes are applied.

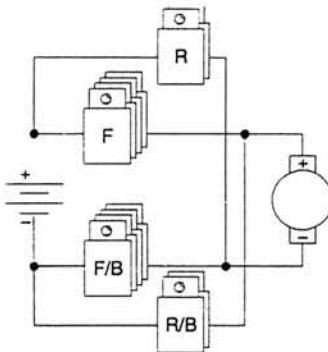
controller with five FETs might have a total resistance of 0.0025 ohm and carry 300 amps. (Motors don't draw this much current, but the higher its current rating, the cooler an ESC will run.)

- Forward/reverse controllers are similar to forward-only units, but they seem much more complicated (see Figure 3). Their FETs are divided into four groups and arranged in an "H" bridge. (The schematic is usually drawn so that it looks like the letter "H," but I think Figure 3 is a little easier to understand.) The FET groups are always operated in pairs. You can see that when the forward (F) and forward/brake (F/B) groups are on, they complete a circuit between the battery and motor so that

the motor runs forward. When the reverse (R) and reverse/brake (R/B) groups are on, they complete a circuit between the motor and battery, but the motor leads are crossed, so the motor runs in reverse. Finally, if the reverse/brake (R/B) and forward/brake (F/B) groups are turned on, they short-circuit the motor and slow it down.

Forward and forward/brake groups usually have four parallel FETs in each group, and the groups are in series (wired end to end). To find *parallel resistance*, you divide by the number of FETs, but to find *series resistance*, you add the resistance of each group. Total resistance works out to be about half that of one FET!

Figure 3.
Forward and reverse ESC.



FETs marked with an "F" are turned on for forward. Those with an "R" are turned on for reverse. When all the "B" FETs are turned on, the brakes are applied.

Choosing a controller

If you plan to buy a speed control, buy an electronic one.

Although cost considerations may justify buying one, mechanical controllers take up too much space, waste your batteries, generate unnecessary heat, wear out quickly and are slow.

Now that I have that off my chest, just what should you look for in an electronic speed control?

- Decide whether you want reverse, whether you want high frequency and how many cells you expect to run.

Here are some tips to help you decide:

- **Running for fun.** If

you drive your car for fun, or if you race only occasionally, I recommend a mid- to high-frequency forward/reverse controller. Most controllers are low- or high-frequency models, but some are mid-frequency. "Low frequency" describes the older 60Hz models. Newer, high-frequency designs typically run at 2500Hz, but some manufacturers go as low as 800Hz for sport models. Most people agree that 2500Hz is close to ideal for efficiency; but at 800 to 1000Hz, you get most of the benefits of high frequency, but will be slightly less likely to suffer from radio interference

Today, the emphasis is on racing, so you won't find too many controllers with reverse, and few people recommend them. Reversing controllers have more voltage drop than forward-only ones, so if you try to race with one, you'll find that it gets hotter, and your speed will be slightly lower. But when you want to imagine you're driving a full-size car, or when you're racing around the backyard without track marshals, reverse is indispensable.

- **Running to win.** On the other hand, if racing is your thing, you want a forward-only, high-frequency controller. Reverse is forbidden

during races, and accidentally using it can get you disqualified. Many forward/reverse units have a reverse delay (even a "lockout") to prevent you from unintentionally using reverse. But to win, you need the low resistance of a forward-only model combined with the higher efficiency of a high-frequency controller.

I don't have anything against low-frequency controllers, but they don't have anything special to offer, either. They don't perform as well at low speeds, and do not offer regenerative braking. US manufacturers are phasing out low-frequency models, but con-

trollers that are bundled with radios will probably continue to be low frequency for some time.

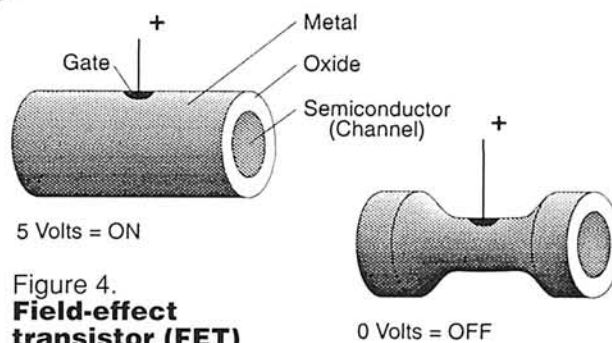
Whether you run for fun or to win, you have to choose a controller that can handle the voltage and current you need. Controllers are not explicitly rated by voltage, but by the number of cells. The current you require is determined by the type of motor (or motors) you use.

Practically any controller on the market can handle 6 cells and a stock motor. If you run modified motors, consult the controller's spec sheet to make sure it can handle the current.

What is a FET?

The acronym "FET" must occur 50 times in this article alone. If you aren't familiar with it, let me explain. First, speed-control FETs are actually MOSFETs. "MOS" is an acronym for metal-oxide semiconductor, and "FET" is an acronym for field-effect transistor. FETs are transistors that use very low power and make excellent amplifiers. In speed controls, they act as high-current switches. They are designed to turn on and off quickly without wasting power. Unlike bipolar (normal) transistors, several FETs can easily be connected in parallel to handle unlimited current.

They're ideal for controlling the high current demanded



ESC GUIDE

DRAG-RACING ESCs

Mfr./model	Dimensions HxWxL (in.)	Weight (oz.)	Max. /Min. V (cells)	CC** (amps)	R1 (ohm)	V drop* (volt)	R2 (ohm)	BEC output (volt)	Price
Astro Flight 206	0.25x1.35x2.0	1.7	20/1	150	0.002	n/a	n/a	none	\$119.95
Novak Hammer Pro	0.65x1.64x1.73	2.7	10/4	300	0.0014	0.03	0.0025	5.93	\$199.00
Tekin 420-G2	1.7x1.4x.6	2.4	20/4	350	0.00125	n/a	n/a	5.0	\$205.00

ENTRY-LEVEL/BUDGET ESCs

Mfr./model	Dimensions HxWxL (in.)	Weight (oz.)	Max. /Min. V (cells)	CC** (amps)	R1 (ohm)	V drop* (volt)	R2 (ohm)	BEC output (volt)	Price
DuraTrax Spike	0.82x1.65x.67	1.27	7/5	150	0.01	n/a	n/a	6.0	\$69.99
Tekin 408-S	1.6x1.5x.6	1.9	8/4	250	0.004	0.09	0.0075	6.0	\$102.50

RACING ESCs

Mfr./model	Dimensions HxWxL (in.)	Weight (oz.)	Max. /Min. V (cells)	CC** (amps)	R1 (ohm)	V drop* (volt)	R2 (ohm)	BEC output (volt)	Price
Novak 410-HPC	0.84x1.4x1.58	1.6	10/4	300	0.0015	0.03	0.0025	5.85	\$195.00
Novak Hammer Pro	0.65x1.64x1.73	2.7	10/4	300	0.0014	0.03	0.0025	5.93	\$199.00
Novak Racer	0.65x1.64x1.73	2.43	10/4	300	0.0030	0.05	n/a	6.0	\$160.00
SCI Power Card 600	0.30x1.62x2.53	2.0	9/4	150	n/a	0/10	0.008	5.96	\$99.00
SCI Power Card 1000	0.30x1.62x2.53	2.0	32/4	260	n/a	0.16	0.013	5.96	\$149.99
SCI Pullman	0.86x1.5x1.6	2.2	28/4	470	n/a	0.07	0.0058	5.68	\$149.99
Tekin 410K	1.4x1.7x.6	2.0	10/4	300	0.0015	0.039	0.0033	6.0	\$220.00
Tekin G-12	1.7x1.4x.6	1.7	12/4	350	0.00125	0.03	0.0025	6.0	\$199.00
Tekin P-12	1.7x1.4x.6	1.7	12/4	300	0.0025	n/a	n/a	6.0	\$150.00
Vantage V410 PF	1.5x2.0x0.7	2.5	10/4	375	0.001	0.030	0.0015	5.0	\$219.00

REVERSING ESCs

Mfr./model	Dimensions HxWxL (in.)	Weight (oz.)	Max. /Min. V (cells)	CC** (amps)	R1 (ohm)	V drop* (volt)	R2 (ohm)	BEC output (volt)	Price
Airtronics Contender	1.03x2.16x1.84	2.8	7/6	120	0.009	0.26	0.021	5.99	\$99.95
Futaba MC210CB	1.79x1.63x1.02	2.55	7/6	142	0.0062	0.27	0.0225	6.14	\$79.95
Hitec SP-520P	0.96x1.62x1.81	2.6	7/5	140	0.012	0.31	0.025	5.6	\$79.95
Hitec SP-560	1.13x1.60x1.85	2.6	7/5	200	0.007	0.19	0.014	5.6	\$99.95
Novak 610-HRV	1.19x1.68x1.76	2.5	10/6	120	0.0065	0.15	0.012	4.98	\$165.00
Novak Rooster	1.2x1.64x2.02	3.0	7/6	100	0.018	0.23	0.019	5.63	\$129.00
SCI Cobra	1.2x1.5x1.63	3.0	10/4	400	n/a	n/a	n/a	5.0	\$149.00
SCI Falcon	1.2x1.5x1.63	3.0	8/4	360	n/a	n/a	n/a	5.0	\$99.00
SCI Monster Card	0.59x2.52x2.94	3.9	20/4	210	n/a	0.30	0.025	5.88	\$249.00
Tekin 610-G	1.9x1.7x.7	2.5	10/6	300	0.00187	0.12	0.010	5.0	\$210.00
Tekin 610-R	1.9x1.7x.7	2.5	10/6	240	0.004	0.132	0.011	5.0	\$142.00

SPORT RACING ESCs

Mfr./model	Dimensions HxWxL (in.)	Weight (oz.)	Max. /Min. V (cells)	CC** (amps)	R1 (ohm)	V drop* (volt)	R2 (ohm)	BEC output (volt)	Price
DuraTrax M5	1.62x1.43x.65	1.94	10/4	n/a	0.003	n/a	n/a	5.7	\$109.99
Novak duster Sport	1.4x1.65x1.7	2.0	10/4	250	0.0030	0.07	0.0058	5.64	\$129.99
SCI Viper	1.2x1.5x1.63	3.0	10/4	1200	0.002	0.09	0.0075	4.95	\$139.00
Tekin 412-P	1.6x1.5x.6	1.9	12/4	250	0.0003	n/a	n/a	6.0	\$108.00

V = voltage, C = current, CC = continuous current; R1 = resistance along full length of wires; R2 = resistance 2 in. along wires.

* along full length of wires ** Forward only

by stock and modified R/C motors.

In advertisements and spec sheets, you'll find several types of FET mentioned. Hyperfet and Goldfet are two names for the same ultra-low-resistance transistor. Megafet is a trade name for another low-resistance FET; TempFET is a trade name for a FET with a built-in temperature sensor.



The basic operation of the MOS-FET is easy to understand. It's a three-layer sandwich. A layer of metal (M) covers a layer of insulating oxide (O), which covers a layer of highly conductive silicon semiconductor (S). Although the configuration is nearly flat, we can imagine it as a faucet (see Figure 4).

A FET behaves like a faucet that can be turned off to stop the current flow. In a FET, an electrode called the "gate" acts as the faucet handle. When voltage is applied, the "faucet" opens to allow current to flow. When voltage is removed, the gate closes and the current stops flowing ("pinch effect"). Therefore, voltage controls the flow of current. In a FET, the voltage is applied to a metal plate that's next to a semiconductor material, and the voltage on the plate makes an electric field that induces charge in the semiconductor and allows the current to flow. If the voltage is removed, the charge disappears and the current stops flowing. The voltage causes the "field," and the "effect" is the induction of charge.

Speed controls use zero and 5 volts to turn the FET on and off like a switch. FET switches are thousands of times faster than mechanical switches and never wear out.

The addresses of the manufacturers featured here are listed alphabetically in the Index of Manufacturers on page 184.

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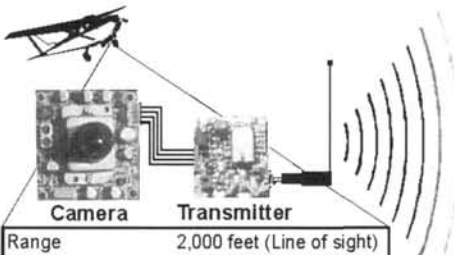
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Mount Your Electronic Speed

by Doug Mertes



THE ELECTRONIC SPEED control (ESC) is among the most critical components in your R/C car or truck. Properly installed and adjusted, a good-quality ESC will give you years of trouble-free service. A poorly set up unit, however, will yield multiple headaches. Let's look at some common issues surrounding speed-control installation and try to avoid some of the typical mistakes.

LOCATION

■ **PROTECTION.** A speed control should be mounted where it will be protected from the indignities of the surface that the car or truck runs on. Install the unit away from the very edge of the chassis, where an errant stone or a splash of water can put it out of commission. If you put your speed control too close to the side of your oval car, for instance, you'll be buying a new one the first time you hit the wall or another car! F1 and 1/12-scale chassis are simply too narrow to give you much room to work with, but, as a rule, try to keep your ESC at least 1/2 inch from the edge.

■ **AIR COOLING.** Don't, however, bury your ESC in the middle of a bunch of other components. ESCs need a stream of cool air to operate at their maximum efficiency. If you close yours up in a box or a balloon, it will soon overheat or shut down. Some racers drill holes in the vehicle's body to ensure adequate airflow, but that isn't really necessary with today's modern speed controls (unless you run a lower body tray that seals all the turbulence out).

■ **BALANCE.** Balance and weight distribution are also factors in ESC placement, especially with lighter cars. If you'll be turning left and right equally often—as in off-road or roadcourse racing—balance your components so that there's equal weight on each side of the car. Off-road cars typically require that you place the receiver on one side of the battery pack and the ESC on the other. In that type of installation, be sure to use a layer of tape or shrink-wrap to cover

and protect the small ESC-to-receiver wires that will run under the battery pack.

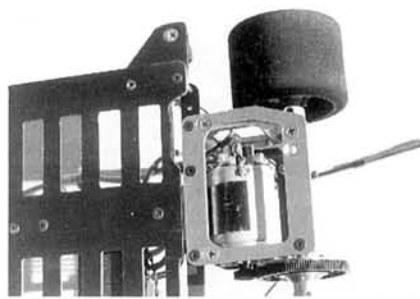
Another option is to mount the ESC on the rear shock tower,

where you can route the wires around the batteries instead of under them. An oval car is usually wedged and staggered all over the place, so it's OK to put the ESC on the right side; its weight is insignificant compared with the left-side-mounted battery pack.

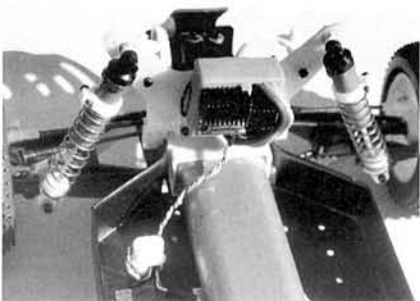
■ **WIRE LENGTH.** Wire length should also play a part in your placement decision. Try to keep all the wires as short as possible, but pay special attention to the battery's negative wire (usually black) and the motor's negative wires (usually blue). The positive battery wire runs directly to the motor without going through a circuit board, and the red ESC power wire pulls very little amperage, so resistance is less of a factor there.

Make sure that you'll be able to visually and manually check and adjust your speed control. Don't put it under a component where you won't be able to see the LED that indicates full speed or neutral. You'll also need access to the torque-control potentiometer (pot)—if your ESC has one.

■ **IN CASE OF AN ACCIDENT.** Anyone who has turn-marshalled knows what it's like to pick up a broken car and try to find the power switch for the ESC. I mount mine close to the speed control, and it's *always* oriented so that the switch works from left to right on the chassis. That way, if a major accident occurs from the front or rear, the



Caps, caps, caps! Read the directions, and be sure to get the right ones in the right places!



Protect your ESC against accidents and flying stones, but don't bury it where you won't be able to adjust it.

ESC as easy as

Control

car won't turn itself off. It's pretty difficult to get hit that hard from the side, but if you do, you'll probably have to pull your car for some other reason anyway.

MOUNTING

The most common mounting method is to use a piece of double-sided servo tape. It works well, but here are a few tips to make your installation last longer:

1 ■ Clean both the ESC case and the mounting area with a rag moistened with motor spray (servo tape doesn't stick to oil or dirt very well!). The two mounting surfaces must be totally clean and free of any old mounting tape or glue.

2 ■ Put the tape on the ESC first, and then take off the second protective-film layer. Heat the tape with a heat gun or a hair dryer for a minute or two, and then stick the tape down onto the mounting area. The ESC will be held better, and when you have to remove it for repairs or re-mounting, the servo tape will come off the ESC in one large piece rather than in fragments.

With many off-road cars, the ESC can be mounted on the shock tower. Start by using the servo-tape method described above, and then run a long, nylon, tie-wrap around the ESC case and the tower for added security; to do this properly, you might have to drill a small hole through the shock tower on either side of the ESC case.

Another option is to make or buy a shelf made out of Lexan, graphite, or Kydex and use it to mount the ESC horizontally on the shock tower. I prefer this method because it

allows me to adjust the ESC much more easily, and the heat sinks tend to stay on the speed control where they belong.

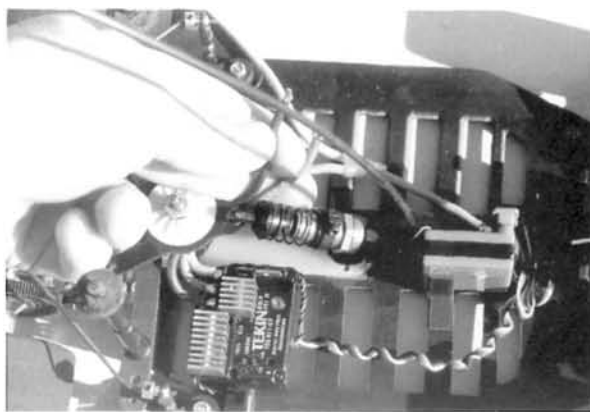
Occasionally, in a pan car—especially in oval cars—I find that the ideal mounting place for an ESC is over a row of unused battery slots. But there's very little area for the servo tape to grip the chassis. I've discovered, though, that a small piece of Lexan— $\frac{1}{4}$ inch larger on each end than the base of the ESC case—can be servo-taped to the speed control and then attached to the chassis plate using 4-40 flat-head screws and locknuts. You can also cut Lexan into $1 \times \frac{1}{4}$ -inch pieces, bend the pieces 90 degrees and servo-tape them to the case and chassis. They'll do a pretty good job of bracing the speed control in the event of an impact.

WIRING

The old saying about measuring twice and cutting once certainly applies to speed-control installation! Wait until you have the unit mounted and you're certain that it's where you want it before you cut the wires to length. Be sure that the wires can be routed properly without being chafed on sharp edges, which could cause a short circuit. Put a motor and a battery pack in the car in the places in which you'll usually have them. Too often, I've seen guys install a speed control with battery or motor wires that are too short.

3 Take the length of your battery and motor plugs into consideration (if you plan to use them). I cut and tin the end of one wire at a time, and then I solder the end into its proper place immediately. That way, I know everything will fit just the way I want it to.

Many speed controls



Try to make the blue and black wires as short as possible, and mount your switch where the turn marshal can find it!

use a three-wire system, with only one red wire coming from the ESC case. To install this type of speed control, run a heavy-gauge piece of red wire from the battery's positive connection to the motor's positive connection. At a point that's at least 2 inches from the battery end, cut a $\frac{1}{4}$ -inch piece of the wire's insulation off. Use rosin-core solder to tin the exposed wire, and solder the end of the ESC's red wire to it. Protect this splice with a piece of medium fuel tubing; it lasts longer than shrink-wrap, and it's reusable!

HAVE WE FINISHED YET?

Almost! Remember to install the ESC heat sinks. Many manufacturers will void the warranty if the heat sinks aren't used, and they don't really weigh very much. Follow the directions that come with your speed control about the installation of the proper capacitors on your motor. All ESCs require three 0.01-microfarad (Mf) capacitors on the motor (can to positive, can to negative, negative to positive). Older, low-frequency ESCs require a polarized, 47mf 25V cap as well. Novak* high-frequency speed controls use a Schottky diode on the motor to improve braking and to protect the ESC from big voltage spikes. Tekin* high-frequency speed controls have an internal Schottky diode, but they use a 2.2mf tantalum cap to protect them from voltage surges. Read the directions, and keep that little instruction book in your toolbox or pit bag for reference! You might also want to keep a spare fuse in there, if your unit uses one. The newest ESCs have reusable fuses, but many earlier models use oddly shaped fuses that are impossible to find when you really need one.

*Addresses are listed alphabetically in the Index of Manufacturers on page 184.



The red wire runs directly from the battery to the motor. Splice in the red ESC power wire, and protect it with fuel tubing or shrink-wrap.

by DOUG MERTES

THE WEAPON

Is Yokomo's YR-4 the ultimate parking lot racer?

ONCE AGAIN, I find myself entranced by the magic of Yokomo's* mechanical design. This time, the YR-4 street chassis has attracted my attention. My dirt track closed, and parking-lot racing has regained popularity, so I'm trying to find the ultimate street weapon: one that will let me put down major horsepower yet won't have to be wrenched on daily! All of my research has indicated that the YR-4 is the way to go.

TWO-SPEED-O-TRONIC

Yokomo offers an optional 2-speed transmission for the YR-4 that has

already been banned from competition by both ROAR and NORRCA. But most of

the folks (some manufacturers estimate as many as 95 percent) who buy R/C equipment don't race with it; they take it out to the parking lot and mess around with their friends! In that environment, a 2-speed would be a pretty cool thing to have.

Does it work, though?

Most assuredly! This device allows you to strap in some truly mega-level horsepower without worrying about gearing, motors overheating, or making run time. And, I have to tell you, it's very cool to hear this rascal shift into second gear after winding out down the straights!

PHOTOS BY WALTER SIDAS



The transmission (no. ZR-0010) costs less than \$100. Two spur gears are attached to separate spur carriers that hold one-way bearings. A clutch housing containing a single spring-loaded shoe fits within the outside spur-gear carrier. Two large inner diameter pinion gears are screwed onto a special pinion carrier that fits on the mounted motor's output shaft. When the car starts from rest, the lower gearing (higher number) is in effect, and the higher gearing simply rotates on the one-way bearing. When shaft rpm reaches the appropriate level, the higher gearing (lower number) is activated by the clutch shoe, and the lower gearing then goes along for the ride. To complete the installation, you'll also need Yokomo's slipper-clutch package (parts no. ZC-674C and ZC-677C). Although the instructions I received were in Japanese, the diagrams made building the tranny very easy.

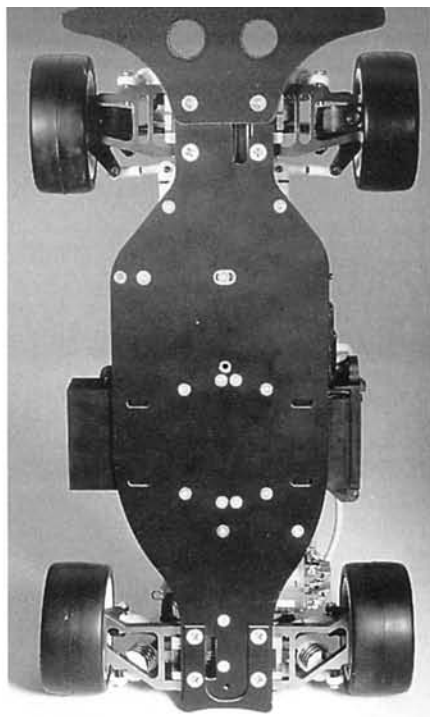
The kit includes both the spurs and the pinions, and it's amazing how few parts there are. You can remove it in just a few minutes if you want to race in a sanctioned event. Because of the design, I think that it won't be too sensitive to dirt or dust, but time will tell how much work it will take to keep things tuned and adjusted. I expect

My intention was to set up this car for the spring Touring Car Sedan series that's being run on parking lots in my part of the country.

it to be very durable, however, because it was originally designed for the rigors of gas competition.

CLASSY CHASSIS

My intention was to set up this car for the spring Touring Car Sedan series that's being run on parking lots in my part of the country. I started by contacting Cliff at Ultimate Hobbies* in Anaheim, CA (the



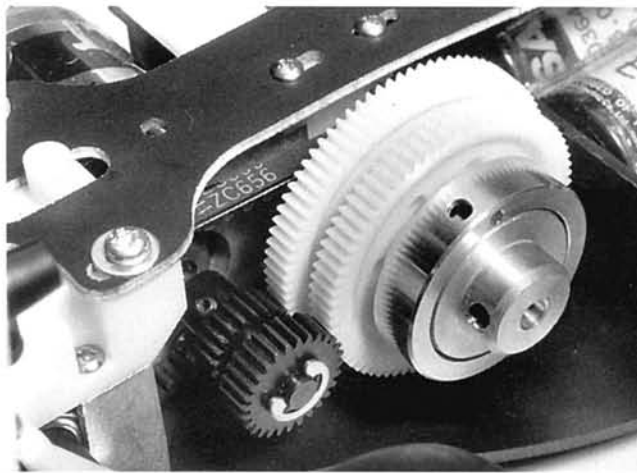
I modified the chassis slightly by removing some material under both the front and rear diffs. If any debris works its way into the diff housings, it will work its way out through the slots.

U.S. importer for Yokomo). It turned out that several generations of kits had been

entire drive system to jam up, so, to provide additional clearance, I cut small windows on the lower chassis plate beneath the front and rear diff pulleys.

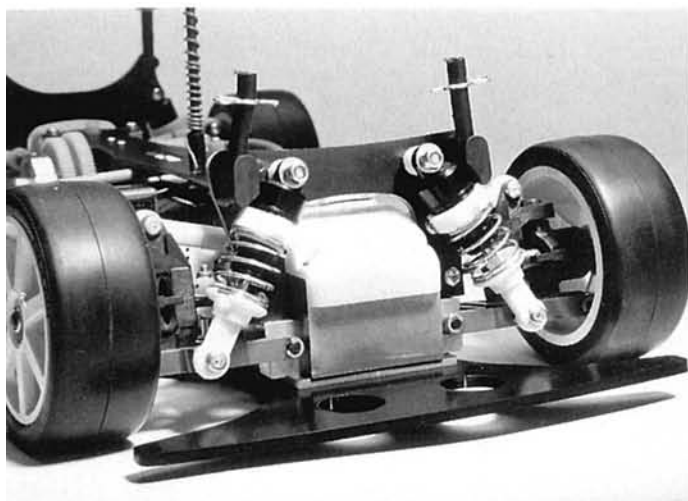
I started by securing the aluminum front and rear bulkheads to the chassis, and then I built the front and rear ball differentials. I used a Team Pit Stop no. 9041 differential upgrade kit that I had in my toolbox. The TPS parts include hardened diff rings and oversize, 3.5mm hardened diff balls. I attached the rings to the outdrives with CA. I had to drill out the diff pulleys slightly to fit the balls. The upgrade includes nylon diff-belt guides for the front pulley that prevent the belts from slipping off if it gets loose or jams. They also have to be secured with CA.

The TPS kit includes new diff-cone spring washers, thrust bearings and spacers. When completed, these upgraded diffs should give an entire season of service without any maintenance whatsoever! TPS isn't producing them any more, but if you see one of these upgrade kits at a hobby



I installed Yokomo's centrifugal-clutch, 2-speed tranny. The unit has relatively few pieces, so it's easy to switch between it and the single-spur setup.

brought into the country, but I was lucky enough to get my hands on what was then the latest version. A newer model, released at the end of '94, has only minor variations in design, such as plastic bulkheads, to distinguish it from the car you see here.



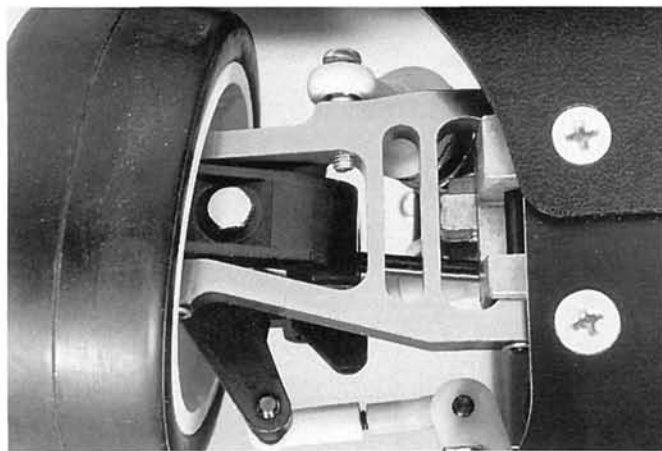
The YR-4 chassis has a double-deck construction with an upper brace that spans the front and rear bulkheads and provides superior chassis rigidity. I had heard that small stones and debris could get caught between the pulley and chassis, causing the

The YR-4's shocks are among the best I've ever used on an on-road car. I filled them with Team Associated's 80WT silicone shock oil and used the standard pistons.

shop, grab it! You might also want to check out Jammin' Jay's* YZ-10 diff rebuild kits.

SUSPEND-O-RAMA

The old Yokomo YZ-10 shocks were a joke. They provided poor, inconsistent damping, and they leaked at the slightest provocation. Few serious racers ever used them; most simply replaced them with Associated units when they built their cars. Not so today! The short black shocks that come with the YR-4 chassis are among the best you'll find on the street. I set them up with 80WT Associated* silicone shock fluid, and



For a totally trick look, I installed a set of Team Suzuki blue-anodized-aluminum, laser-cut suspension arms. They aren't lighter, but they're more rigid and they look great.

they were absolutely smooth and leak-free. I'd seriously consider upgrading to these shocks on any on-road chassis. I used the kit's spring preload rings (large in the rear, medium in front) to give me the suspension balance I needed.

When I was in the middle of assembling the suspension, I talked with the guys at Ultimate Hobbies again. It turned out that Team Suzuki was racing YR-4s in Japan, and they had developed a neat set of machined, blue-anodized-aluminum suspension arms for the car (no. TS-CS02). Would I be interested in a set for the project car? Needless to say, I got another visit from the UPS man within a few days! Compared with the kit's nylon arms, there isn't a huge weight saving, but the aluminum ones are appreciably stiffer, and they seem to give a greater feeling of precision in tight S-turns and sweepers. They also look really neat—truly exotic!

With the kit, Yokomo includes a set of one-piece wheels and slick tires that are equal to the best offered by after-market suppliers. The rear ones are wider than the fronts, but, if you choose, you can also fit any HPI or Tamiya rim by using a set of pin drive adapters from Ultimate, HPI*, or Hobby Etc.*. The red plastic hex drives that come with Tamiya kits will also work. Remember to roughen the insides of the rim grooves with a Dremel tool and cutting disk or a file, and carefully glue the tires to the rims with CA after you've inserted a sponge liner of the proper density.

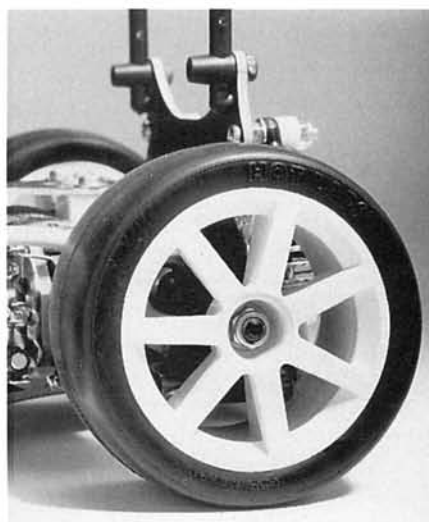
BODACIOUS BODY

I wanted a serious body to go along with this serious chassis, so I turned to the crew at G.H.I. Distributing*. They're now the exclusive importers of the Elite line of touring car bodies, which are gorgeous. Touring sedan bodies typically have much

more detail than stock-car and off-road bodies, because most racers in this class like to paint their rides to look like the real thing. I chose an Alfa Romeo T-155 body, because I had admired the Alfa team's success in the European series for the last two years.

I didn't want to use a paint scheme that I'd see all over the place, though, so I made up my own

design, which is similar to the graphics used on many cars in the Touring Car Class. Mike Leahy of ...and Design* cut the Miller logos for me, and the rest of the decals came from the new Parma* Touring Car sheets (nos. 10737 and 10762). Both



Yokomo's new Hot Laps slick tires come with the kit. Earlier YR-4 kits came with foam tires.

contain black-and-white schemes, so you can set up an entire car, no matter what the primary color is.

The kit-supplied body posts look as though they'll take a lot of abuse, and they can be reversed, back to front, so that you can set up virtually any style of body. Use a heat gun to soften them up a little if you need to bend them forward or backward to fit your application. All the narrow stock-car bodies will fit, but if you want something a little out of the ordinary, the Elite line also includes a Toyota Supra, a Civic Hatchback, a Porsche 911, a Nissan Silvia and a BMW M3.

ELECTRIFYING ELECTRONICS

In the spirit of parking-lot racing, I didn't go whole-hog on the electronics. A car set up for this kind of use shouldn't need the latest in hi-zoot voltage handlers, yet I wanted to install something capable of handling the big-amp demands of high-rpm modified motors. I chose a matched set of 1700SCRC Sanyo batteries from Elite Speed Products*, one of my trusty Tekin* 411P speed controls (high frequency; torque control; been around for years), a Novak* NER3-FM receiver, and a Futaba* 9601 steering servo. My favorite radio is the JR* 756, and, because it has memory for up to six models, I used it for the Yokomo.

For go-go power to match the 2-speed tranny, I contacted Ken Jones at BBR Motors*. Ken has been around R/C cars for a long time, and his BBR Lotec bodies have won numerous titles in both 1/10- and 1/12-scale racing. In his latest venture, Black Box Racing Motorspeed, he works with the customer to determine the optimum motor wind for each use. After the armature has been custom-wound, the motor is assembled and tested to ensure quality. You can keep your motor up to full speed by using Ken's rebuild services. Neat stuff!

You might notice that I hard-wired everything into place. That's because I usually travel with a soldering iron, and I don't like the bother of connectors. If I were going to use this car to run some fun packs with my buds, though, I would install a set of high-quality, low-loss Deans*, Race Prep*, or Lightspeed/Sermos* connectors for the battery setup.

WHATZIT LIKE?

The weather wasn't too cooperative when I first tested the YR-4. I had hoped to run it on a smooth, flat parking lot that had been paved recently; it's too bad that heavy rain and cold temperatures prevented me from following up on my plans. I was, however, able to run the car in a large indoor area, so I got an idea about how it handles. My desire to hear the tranny shift into second was also fulfilled. When that happens, the car just squats down and takes off faster than ever. A full 5-minute run left the motor barely warm and me ready for springtime!

If you're looking for something truly different to run outside on a paved surface, you'd have a hard time finding a more distinctive alternative (or one of higher quality) than a Yokomo YR-4. And don't forget the 2-speed tranny option!

* Addresses are listed alphabetically in the Index of Manufacturers on page 184. ■



Build Battery Packs

T A K E C H A R G E

TO A BEGINNER, building that first battery pack might seem overwhelming. A ton of people out there don't feel too secure about soldering up a battery pack because of all the stories they've heard; for example: if you apply too much heat to the cells when you solder them, you may damage them. Others think they might not have the proper equipment to solder the pack correctly. Well, those two factors *are* important, but they shouldn't put you off completely. If you heat the tip of a cell for too long, you will damage it. If you don't have the right equipment, you obviously risk ruining your cell (and once it has been damaged, it can't be repaired). See why some people hesitate to assemble their own packs?

It's so easy to pick up an assembled pack at your hobby shop, so

why do people make their own? Easy! *It offers a few advantages:*

- Most high-end racing cells are sold individually and are rarely ever found assembled in packs. So if you want the *best* pack, you have to make it yourself.
- If you'd like to match cells or have someone match them for you, you might want to assemble your own packs.
- If you ever need a saddle-pack battery setup, e.g., for a pan car, then you'll have to build your own pack!

That's why we've prepared this step-by-step article to show how to assemble the two most common styles of battery pack: stick packs and side-by-side packs. We also give you the lowdown on the equipment you'll need; so read on and start warming up that soldering iron.

THINGS YOU'LL NEED

Essentials

- **Solder.** Archer 60/40 rosin-core is preferable and is readily available from Radio Shack.
- **Battery bars.** These are used to link the cells. There are copper, silver braid, gold and silver-plated-copper bars.
- **Battery-building kit**—for building stick packs only. We used Trinity's* Stick Pack building kit (no. RC 5104), which includes everything you need: individual cell shrink-wrap, CU 64 copper battery bars, battery washers (to use on the cells' positive terminals—prevents them from shorting), and a length of 13AWG wire including a Tamiya-style battery connector.

Optional items

- **A battery jig**—helps to keep the cells properly aligned and holds them while you solder them together.
- **Shoe-Goo.** Instead of using CA to keep cells together and side-by-side, use Shoe-Goo. If you ever want to separate the cells for any reason, they'll come apart more easily. You don't have to worry about tearing off the cells' shrink-wrap material; just peel off the Shoe-Goo, and the cells will come apart.
- **Needle-nose pliers.** When you solder battery bars, they get quite hot, so don't try to hold them in your hands. (Fingertips don't groove too well with metal that's absorbing 600 to 750 degrees!) Use pliers to position the battery bar just right.

LET'S START

Side-by-side packs

This is the type most usually used by racers. In this configuration, the cells can easily be disassembled for re-matching, reconditioning and even re-configuring. These packs are also easier to build than stick packs.



Here are the items you'll need to solder up a side-by-side battery pack (the battery jig is optional).

PICK THE PROPER IRON

There are two features to look for in an iron—wattage and operating temperature. To do the job properly, use an iron that can reach a temperature of at least 600 to 750 degrees Fahrenheit. But remember: the hotter the iron, the less time it takes to make a good solder joint. The shorter the time that heat is on the cell, the less you're likely to damage it.

Irons with higher wattage ratings will heat up quickly and maintain their temperature better than irons with lower ratings. For the best results, choose at least a 40W iron.

One of our favorites is the Ungar* Super Race



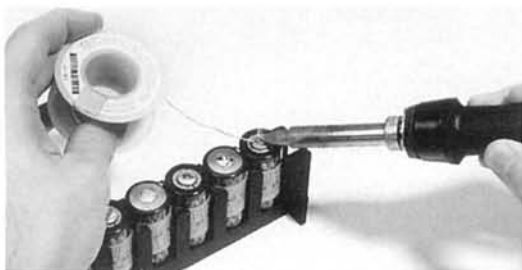
and it comes with a base/stand and a tip-cleaning sponge.

Station. It has a thermostat, so you can control its temperature more precisely, and its base/stand contains a tip-cleaning sponge.

If don't have access to AC power, certain units, such as Ungar's 12V Super Iron, work off any 12V power supply, e.g., a car battery, and companies such as Wahl and Iroda offer portable irons that are powered by butane.

It's time to move on to the next step: getting your gear together.

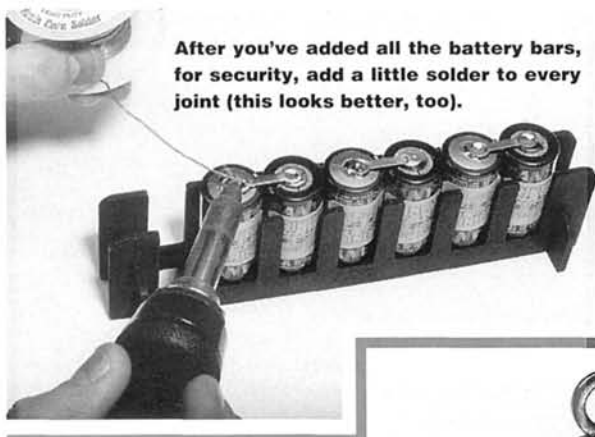
Ungar's AC-powered Super Race Station is equipped with a thermostat for precise temperature control, and it comes with a base/stand and a tip-cleaning sponge.



Tin each end of every cell. When the solder has flowed onto the top of each one, be sure to remove the heat as quickly as possible.

Step 1.

Put the cells together in the proper order. At this point, a battery jig is useful. To ensure a good bond between the solder and the cells, use a small paintbrush to spread rosin flux over the end of each cell. Next, tin the ends of each cell with solder. Then hold the tip of the iron against the area and apply the solder to the tip. Take the heat away from the cell as soon as the solder flows onto it!



After you've added all the battery bars, for security, add a little solder to every joint (this looks better, too).

If you plan to hard-wire your packs to your ESC, this is what you'll have to do. Bend two battery bars in the middle at a 90-degree angle, then solder them onto the remaining ends of the pack, as shown in the photo.



Step 3.

Finally, add connector leads or solder tabs.

Use tabs if you plan to hard-wire your packs to your electronic speed control. To add the two tabs, tin both sides of two battery bars, and solder the bars to the positive and negative ends of the only two cells that don't have battery bars on them. That's it; you've assembled your battery pack!

If you plan to use more than one battery, you might want to use connectors. To make connector leads, strip approximately 1/4 inch of insulation off the ends of the wires, and tin the exposed ends with solder. Now hold the tinned end on the cell. The solder that's on the wire and the cell should flow together and form a solid joint.



To position the battery bar properly between the two cells, grab its middle between the tips of a needle-nose pliers. By doing this, you avoid burning your fingers while you try to position the bar.

Step 2.

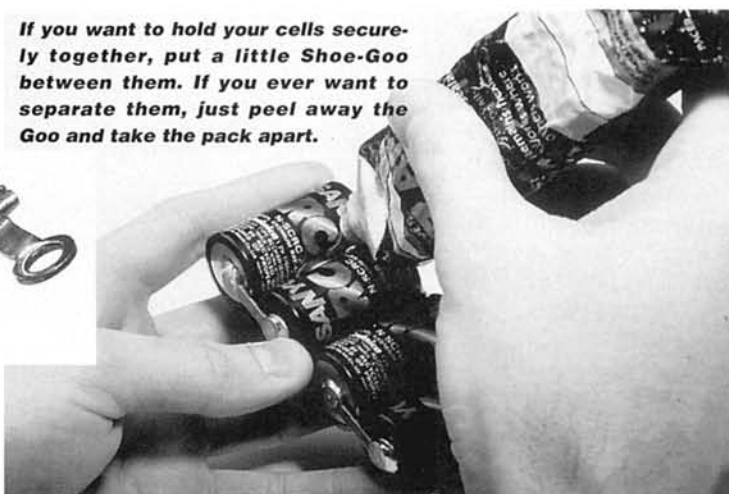
You've now reached the hardest part—adding the battery bars; but don't panic; it's relatively easy. This is the easiest way:

- grab the middle of the battery bar with the needle-nose pliers;
- tin each side of the battery bar with solder;
- put the battery bar between the two cells, and apply heat to each side until the joint has been made. Remember: remove the heat as fast as you can.

Alternative method:

- put the bar directly on top of the two cells;
- apply the heat, and solder the bar on both ends without tinning it first. (This works, but the first method is slightly easier.)

If you want to hold your cells securely together, put a little Shoe-Goo between them. If you ever want to separate them, just peel away the Goo and take the pack apart.



When you've finished assembling your battery pack, clean your solder joints by wiping them with a motor-spray-moistened rag.





Here's what you'll need to build a stick pack. We used Trinity's Battery Pack Kit.

Stick packs

Slightly narrower and shorter than side-by-side packs, these are the most common type of pre-assembled battery pack. Some vehicles accept only stick packs. Most are made of unmatched cells that have been assembled by their manufacturer, but if you want to make your own stick pack out of killer matched cells, here's how you do it. We used Trinity's Stick Pack Building Kit.

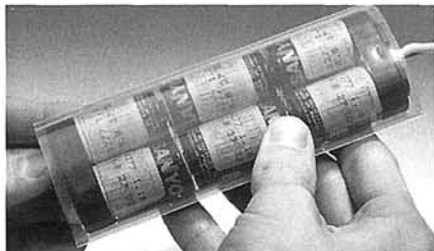
Step 4.

Slide the included shotgun-barrel-type tube over the cells. This keeps the cells together—even in a crash or during a harsh ride.

When the cells are together, hold them firmly by sliding the included shotgun-style tube over them.



Before you solder the connector to the battery pack, run the leads through the battery's connector cap, and then slide the endcap over the end of the cells. Next, place the other endcap over the bottom of the cells.



Slide the shrink-wrap over the battery pack, making sure that there's enough of it to overlap the whole pack before you apply heat to it.

Step 1.

Tin each cell as you would when building a side-by-side pack. (Refer to Step 1 of the side-by-side pack construction.)



Configure the cells as you would for a side-by-side battery-pack, but solder on metal tabs instead of battery bars. But before you solder on the tabs, don't forget to add the small nylon disks to the appropriate cells.

bars, they wouldn't bend easily and so couldn't be properly configured, and the battery would be longer.

Step 2.

Repeat Step 2 of the previous construction process, but this time, use thin, flexible, metal tabs instead of thick battery bars. When the cells are aligned (end to end), you have to bend and compress those tabs, and if they were thick, like battery



Remove the cells and carefully bend all the tabs in the middle so they look like the letter "m."

When you've finished arranging the cells, you should have two columns of three with the polarity flipped on each side.

Step 3.

When the metal tabs have been soldered onto the cells, remove them from your battery jig (if you use one), and then bend the tabs so that the cells are arranged end to end. Bend the tab in the middle so that it resembles an "m." Push the cells together so that the ends of the cells sandwich the tabs. You'll now have two rows of three cells with a positive cell and a negative cell open on one end.

Step 5.

Now attach your battery connector to the tops of the soldered cells. If you plan to use a battery endcap, run the connector leads through that first before you solder the leads to the battery. Put the remaining endcap over the bottom of the pack, and then slide the shrink-wrap over the entire assembly. Be sure to have enough shrink-wrap to cover both ends of the pack,



Heat the shrink-wrap evenly with a hair dryer.

and use a hair dryer to shrink the wrap uniformly over the entire assembly. That's it! Your battery pack is lookin' pretty good.

Now, that wasn't too bad, was it? Pretty soon, with a little practice, you'll be soldering up packs like a pro. Now turn off that soldering iron before you burn the house down!

*Addresses are listed alphabetically in the Index of Manufacturers on page 184.

15th
ANNUAL

CLEVELAND INDOOR CHAMPS

PRESENTED BY NORCAR



Modified class champion Jon Orr shakes the hand of NORCAR President Chuck Mackin.

WEDNESDAY, NOVEMBER 23, the Holiday Inn, Independence, OH. Snow greeted the approximately 240 racers who were arriving for the prestigious 4-cell, 1/12-Scale U.S. Indoor Championships hosted by NORCAR.

Track crew members laid the carpet on the plywood that the Holiday Inn personnel put over the ballroom floor, while racers checked in to get an early start on the four-day event. They came from Holland, Germany, Switzerland, Great Britain, Canada and 18 states of the USA. All received an official race T-shirt and a colorful Parma* tote bag stuffed with literature from well-known manufacturers.

On Thursday, the heat board was set, and practice rounds were run. To give racers an idea of how qualifying would be run, transponders were used for the second of the four practices. After the third practice

round, race director Dan O'Malley held a drivers' meeting, and after the fourth practice round, the ballroom was closed for the night to allow racers and workers to get a little sleep before the flurry of qualifying would begin.

QUALIFYING

The five qualifying rounds began on Friday and continued through Saturday—Stock

Masters class champion Junior Norton proudly displays his TQ and first-place plaques.



4 **ON THE**
Floor

by LINDA CARRUBBA

PHOTOS BY ED & TONY HALLMARK



Stock champion Mark Adams (left) and Modified champion Jon Orr (right) take time out to pose for the camera.

Class then Masters, then Modified.

• **Stock.** After four exciting rounds, Jeff Brown's 43/8:09.58 was the target score, but after all 12 heats—during which all did their best to knock Jeff off the top of the pile—Jeff was left standing as Top Qualifier.

• **Masters**—five rounds of vying for top honors. Only Junior Norton was able to drive flawlessly (his lap times?; only from 11.1 to 11.8—not one long lap) and claim to be the first-ever Masters TQ in this event with 42/8:00.72.

• **Modified.** During the first four rounds, Mike Blackstock and Josh Cyrul alternated as TQ. Coming into round five, drivers anticipated beating Josh Cyrul's 46/8:08.51 run, but only one driver was able to overtake him: Mike Blackstock regained the TQ spot with 46/8:06.77.

STOCK MAINS

At 9 a.m., a hush fell over the crowd! (not really, but I've always wanted to write

that!). After singing the National Anthem to the cheering audience, Parma's Garry Owen introduced the 10 A-Main drivers. The cars were gridded, the corner marshals looked alive, Garry said "Go!!!"

Jeff Brown took the lead, and on the second lap, a major crash put Vicky Carrubba into last position. On lap three it was Brown, Chad Coppock, Andy Power, Mark Adams and Robert Van Wagner. Jeff had about a 2-second lead (one straightaway), then he got stuck on a board, so with 6:40 to go, Chad went up front. Chad had won in Stock last year; could he win again? With 6:15 left in the race, the leaders were Coppock, Power and Adams.

Then Adams passed Power, Coppock hit a wall, and the new order was Adams, Coppock and Power. This prompted Garry Owen to announce: "So far, being in the lead in this race is *not* a good deal!" With 5:25 to go, there was a big tangle, and Adams, Gerber, Coppock and VanWagner emerged in that order. While Adams and Gerber battled for first, Van Wagner hit a wall, and, with 4:05 to go, Vicky Carrubba had the fastest lap time and appeared to be on the move.

With 4:05 to go, it was Adams, Gerber, Williams, VanWagner and Carrubba. Garry announced: "2:40 left to go; the leader in traffic." All the back markers, showing a little American courtesy, moved out of the leaders' way. With 1:40 to go, the top five—Adams, Gerber, Williams, VanWagner and Carrubba—were all on the same lap. Carrubba passed VanWagner for fourth; Mark Adams was still turning 11.8 laps;

SPECIAL EVENTS

After the qualifying rounds, NORCAR hosted the special events of the day: "tee-time" practice, a pizza party and the Concours/Best Paint contest. The room was cleared, and all the cars to be judged were placed on the drivers' stand. While judge D.J. Renwick—many-time national and regional concours winner—studied each body and car, Ted McCarthy and Al and Danielle Coppock took down names for tee-times which were held from 7:30 p.m. to 11:30 p.m.

CONCOURS

FIRST Terry Fogleson's pink "Bubblegum Explosion." You had to see it to understand how an explosion of bubble gum could win anything!

SECOND Rick Smith's blue design.

THIRD David Greer's "Beauty and Death"—a takeoff of the Guns 'n' Roses design.

BEST PAINT

FIRST Ross Schweizer's dragon design.

SECOND Dave Morrow's X-rated body. (We don't want to discuss it here!)

THIRD Eli Ezrow's "Flames and Stuff."

There were very many other hot bodies, which racers had worked really hard on. The winning bodies didn't have to be run in the Mains, so most of them were displayed in the NORCAR showcase in the hallway leading to the ballroom.



A view of the track layout for the 15th Annual U.S. Indoor Champs.

W I N N E R S C H A R T

Stock A-Main

Pos.	Driver	Laps	Time
1	Mark Adams	42	8:10.60
2	Wayne Gerber	42	8:11.46
3	Scott Williams	41	8:04.13
4	Vicky Carrubba	41	8:05.37
5	Robert VanWagner	41	8:08.60
6	Peter Maiolo	40	8:00.47
7	Jeff Villemure	40	8:00.51
8	Chad Coppock	40	8:04.23
9	Andy Power	40	8:08.79
10	Jeff Brown (TQ)	DNF	DNF

Masters A-Main

Pos.	Driver	Laps	Time
1	Junior Norton (TQ)	42	8:08.29
2	Paul Martin	42	8:09.01
3	Carl Christy	41	8:08.98
4	Jerry Cyrul	41	8:09.62
5	Skip Starkey	41	8:09.75
6	Steve LaFara	41	8:10.99
7	Dave Berry	41	8:11.20
8	Bob Schoenau	41	8:11.57
9	Chuck Lonergan	40	8:00.73
10	Bud Bartos	40	8:01.05

Modified A-Main

Pos.	Driver	Laps	Time
1	Jon Orr	45	8:00.20
2	Joel Johnson	45	8:00.46
3	Mike Blackstock (TQ)	45	8:04.87
4	Steve Radecky	45	8:08.46
5	Frank Calandra	45	8:08.97
6	Mike Lufaso	45	8:13.19
7	Josh Cyrul	44	8:00.48
8	Brian Kinwald	44	8:03.92
9	Andy Griffiths	44	8:04.25
10	Kevin Jellich	44	8:05.09

Gerber was still running fast. Adams and Gerber got another lap; time ran out for the rest of the field; Adams played it safe and stayed in the middle of the track to go on to win the Stock Class.

MASTERS

This was the first ever Masters class at this event. TQ Junior Norton immediately jumped into the lead with Paul Martin right on his tailpipe and Carl Christy, Bob Schoenau and Chuck Lonergan close behind. The racers continued in this order until there was 5:45 left to race.

Carl Christy's car was hit and wound up last. The halfway mark saw Martin moving up on Junior—in Garry's words, "Junior is running a tight line; Paul is also running a tight—oops! A little *too* tight!" Paul Martin went a little too close to the board and the board grabbed his car.

Despite that bobble, the racing continued with Junior in the lead, Paul in second and Lonergan in third. With 3 minutes left, cars were running in the same order, and only 2 seconds separated Junior and Paul; Christy was making the fastest laps and trying to regain lost ground. With only 1:45

left, the battle for third was between Lonergan, Skip Starkey and Jerry Cyrul; Christy was just out of the running—or so it seemed.

Suddenly, the battle for third became a collision. This didn't affect the top two cars, but Lonergan ended up in third with Christy fourth and closing on him. With 45 seconds left, Carl grabbed third; on the last lap, Junior Norton continued as he had started—in the lead—and became NORCAR's first-ever Masters class TQ and champion! The nine other drivers shook his hand as they left the stand.

MODIFIED

Would TQ Mike Blackstock take an early lead and win?; could last year's Modified champ, Joel Johnson, come from fourth qualifying position and magically win yet another U.S. Indoor Champs?; or would some new racer out-drive the other nine to win the race?

The race began smoothly, but on the second lap, at the end of the straightaway, Josh Cyrul's car flipped over the wall and into the crowd! The order was Joel Johnson, Jon Orr, Mike Lufaso, running 10.5-, 10.7- and 10.8-second laps, respectively. At the 8-minute mark, the order was the same. Andy Griffiths (from England) made a bid for third, but he tapped another car and pulled over to wait for the field to pass. (You see, in Europe you *penalize yourself* if you make a mistake. Maybe we should try it here?)

With 5:25 to go, Joel still held the lead and was followed by Jon Orr and Josh

Cyrul. In fourth, Mike Blackstock was hanging back, running 10.3 laps, but waiting to make a move. With 4:40 to go, he passed Cyrul, and Frank Calandra was pushing Josh. Joel was running 10.5-second laps, Jon Orr (second) was running 10.5, but Blackstock was running 10.3-second laps.

With 3:40 to go, the top seven cars—Joel, Jon Orr, Blackstock, Josh Cyrul, Frank Calandra, Steve Radecky and Mike Lufaso were all still on the same lap. With 2:30 to go, Jon Orr was gaining ground on Joel; the difference on the computer screen was just less than 1 second, and we could see distance between them shrinking.

Garry announced, "One minute to race," and Jon Orr started stalking! For a few laps, Joel's lap times were 11.0 and Jon's were 10.9. With 10 seconds left in the race, Joel and Jon crossed the line for their last lap. In front of the drivers' stand, Jon tried unsuccessfully to pass Joel; then, as the cars reached the straightaway, Jon ducked inside Joel and took the lead. The finish line was two turns away, and Joel was right behind Jon. As "Time" was called, Jon became the 1994 U.S. Indoor Modified Champion; only 0.26 second behind, Joel placed second; Mike Blackstock finished third. Many thanks to Jon and Joel for making the race so exciting; I thought announcer Garry was about to have a heart attack!

Again, many thanks to all who donated prizes, literature, time and/or energy to making NORCAR's 15th Annual U.S. Indoor Championships the most exciting in its history. Most racers went home all "raced-out"! ■



Stock champion Mark Adams receives his plaque from NORCAR president Chuck Mackin.

TECH HEAD

by Frank Masi

Slipper Clutches

clutch (klŭch) *n.* Any of various devices for engaging and disengaging two working parts of a shaft or of a shaft and a driving mechanism.

THE CLUTCH in your full-size car completely disengages the engine from the transmission so you can take off smoothly and change gears. The slipper clutch in your R/C car slightly disengages the motor from the transmission to limit torque to the drive wheels, prevent excessive wheelspin and save on wear and tear of the driveline parts.

Why do we need slipper clutches?

Electric motors develop their greatest torque at zero rpm, or start-up. For best traction, however,

less torque at start-up is desirable. It would be nearly impossible for the motor's full start-up torque to be transmitted to the tires without some wheelspin. Any time the wheels are spinning, energy is wasted, and the car becomes much less stable from side to side. A slipper clutch remedies this problem.

How does it work?

The primary function of the slipper is to limit the motor's substantial start-up torque. It does this with friction. To get an idea of how a slipper works, study the diagram that shows the basic parts of a slipper clutch (Figure 1). Note that the spur gear (A) is directly attached to the outer slipper plate (B). The inner slipper plate (D) is direct-

ly attached to the transmission's input shaft (E). When the clutch is assembled (see Figure 2), the two slipper plates sandwich the friction pad (C). The amount of slippage that occurs is determined by the amount of pressure that's placed on the pad by the two plates. A spring, slid over the transmission input shaft and held by a small nut, forces the two plates together. Pressure is increased by tightening the nut and further compressing the spring.

Two conditions cause the clutch to slip:

- Input torque from the motor that's greater than the clutch's "slip point," i.e., how tightly it has been set. The clutch will slip when the car accelerates from a dead stop. By slip, I mean that the

outer plate is spinning faster than the inner plate. Because of the friction pad, the inner plate's rpm will eventually match that of the outer plate, and the clutch will cease to slip. How quickly this happens depends on how tightly the clutch has been set.

- Feedback torque from the transmission. Landing from jumps and driving through bumps are some of the causes of feedback torque. Example: the driven wheels of a car traveling over a jump may actually speed up as the car becomes airborne. This is caused by the sudden release of load from the drive train. When the car lands, the load is replaced twofold as the car slams back onto terra firma and its tires skid in an attempt

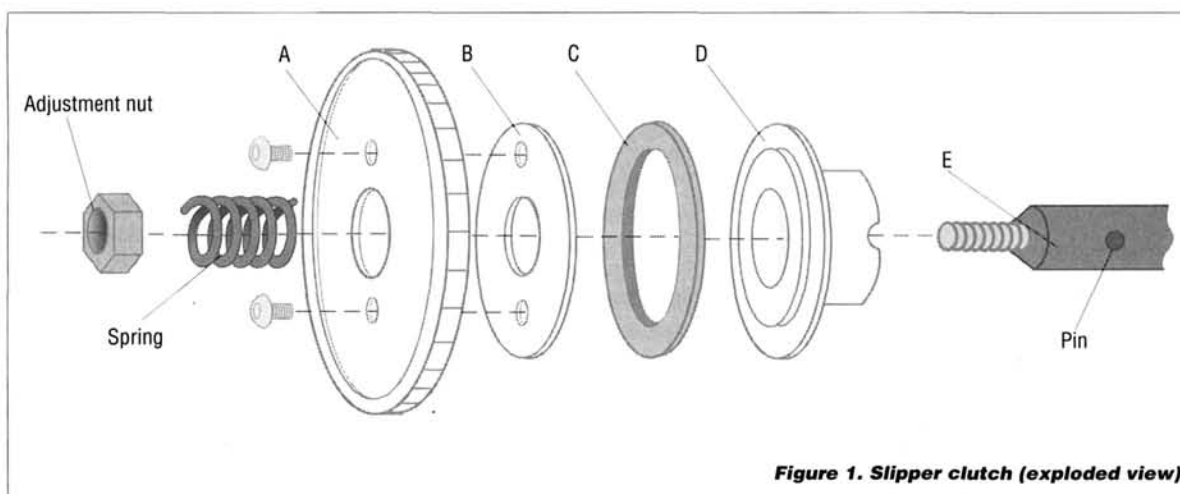
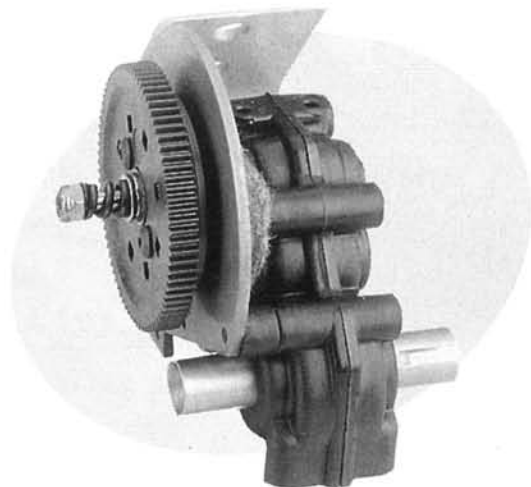


Figure 1. Slipper clutch (exploded view).

Setting a slipper clutch

The diff should never slip! Ever! Let the slipper do its job. Here's the best way to set a ball diff and a slipper clutch:

- 1 Lock the slipper clutch by tightening its adjustment nut until the spring is completely compressed.
- 2 Hold both tires to prevent them from spinning, then try to spin the spur gear; it shouldn't move.
- 3 If you can spin the spur gear, tighten the ball diff in small increments until it's impossible to spin the gear using your bare hands. The diff is now set correctly. Be careful not to over-tighten the diff.
- 4 Loosen the slipper adjustment nut a little at a time until you can spin the spur gear. It should be difficult to spin the gear.

Final setting should be made on the track. Place the car on the track, and perform a full-throttle start from a dead stop. For high-bite tracks made of loose, fluffy dirt, the tires should spin slightly. For hard-packed, but sticky tracks (where you'd use a mini-pin tire), the clutch should slip for about 2 feet. On a slippery track, place the car on the area of the track that offers the least traction. Perform a takeoff; the tires shouldn't spin at all, and the clutch should slip for about 3 to 4 feet. Warning: excessive slippage can damage the clutch. If, to gain traction, you usually resort to excessive clutch slippage, try using different tires or a less powerful motor instead.

to match the much slower speed at which the car is now traveling. This is why many cars get so out of shape over jumps; anytime the tires break contact with the ground, side-to-side stability is diminished. A slipper that works correctly will

absorb much of this shock and prevent loss of traction.

More on slippers

Although they may vary slightly, all slipper clutches are essentially similar in design and function. Some use small

pegs in place of the slipper pad; some sandwich the spur gear between the pressure plates. The descriptions and the setting tips given in this column should apply to all R/C car slippers.

Team Losi's* Hydra Drive traction-control system is designed to allow a much looser slipper setting. It's basically a "slipper for the slipper clutch," that can significantly improve your car's performance on super-slick or very bumpy tracks. In a future column, I'll discuss the design and workings of the Hydra Drive in more detail.

*Addresses are listed alphabetically in the Index of Manufacturers on page 184.

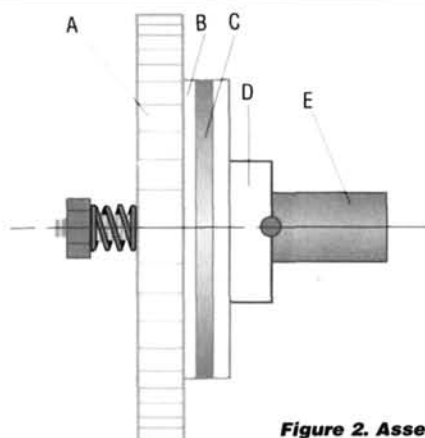


Figure 2. Assembled slipper clutch.



Here's proof that the Powerzone Comm.

Drops are #1 Performance Test

Before	Powerzone Comm. Drops were added	Constant Volt 5.00				
		RPM	TORQ	WATT	EF	AMPS
		15379	1.4	16	50	6.4
		13921	3.0	30	66	8.9
		11993	5.0	44	67	13.0
		9954	7.0	52	58	17.9
		8125	9.0	55	55	23.0
		6160	11.0	50	35	28.4

Stock motor dyno readouts taken after simulated four minute run using the same motor before Powerzone Comm. Drops were added and after one drop was added.

After	Powerzone Comm. Drops were added	Constant Volt 5.00				
		RPM	TORQ	WATT	EF	AMPS
		15660	1.4	16	47	6.8
		14430	3.0	31	62	10.1
		12591	5.0	46	64	14.0
		10724	7.0	56	60	18.4
		9131	9.0	61	53	23.1
		7272	11.0	59	41	28.2

18% increase in RPM
17% increase in Efficiency.
18% increase in Wattage Output.

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Grassroots

RACING

This is YOUR PAGE—YOURS!! It belongs to you, the optimistic local racer on a budget who's looking for some evenly matched action; the individual who's in it for the fun of it all: the grassroots racer—whether on-road or off-road. We at Car Action really do want to see your tracks, your cars and your local heroes—men, women, boys and girls (we love cats and dogs, too!). Show us your local racing scene! Send photos with captions to "Grassroots Racing," Radio Control Car Action, 251 Danbury Rd., Wilton, CT 06897-3035.

call now!

If you're a dealer or just a bunch of fun-lovers in search of a race program, call now! Here's a few hot-line phone numbers that you can use if you have any questions, or if you'd like to start a program in your area.

Bolink Legend Series
(404) 963-0252

Tamiya R/C Championship Series
(800) TAMIYA-A

Kyosho R/C Sport Racing
(800) 682-8948, ext. 085F

Hobby Shack Parking Lot
(714) 964-8846

Hobby Town USA Parking Lot
(402) 434-5050

Trinity's Street SPEC Series
(908) 862-1705



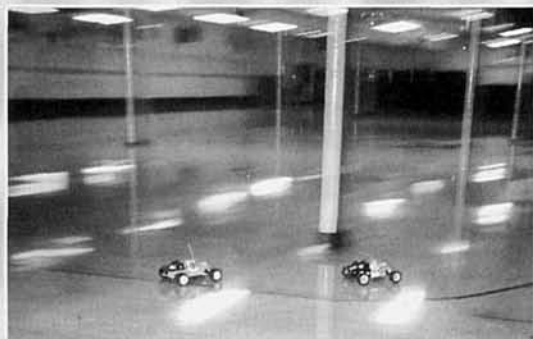
Left: here are a few of the participants in the 1/8- and 1/10-scale gas Snowball Rally that was held at the Dixie Race Club in Atlanta, GA. Seventy racers from 14 states gathered to attend this event. The 1/8-scale A-Main lasted 30 minutes, and the 1/10-scale A-Main ran for 20 minutes. Above: race director Darryl Schwartz should be commended for running the program smoothly and on schedule.



Right: this ultra-fast parking-lot track was sprayed three times with Coca-Cola to increase traction and, according to the racers, traction was nearly perfect.



When the winter weather turns nasty in Kent, OH, racers turn to the Moon Glo roller-skating rink for some intense racing action. According



to the club's president, Steve Jacobs, they get 35 to 40 racers every Thursday night for a few qualifying heats and then a 4-minute main event. Looks like fun.

There's always a helping hand to be found at Hobbytown Raceway Inc., in McHenry, IL. Here, Aero-Car Technology representatives are rebuilding the tranny and diff on Missy's Associated RC10T. For information on Hobbytown Raceway Inc., call Patty Hollingsworth at (815) 344-1777.



FROM TIME TRIALS TO TROPHIES

by Mike Meyers

WHEN IT COMES TO R/C car racing, the 4-year-old Adrian R/C Club is a mixture of the old and the new. The membership consists of a lot of kids and almost as many adults, all of whom enjoy racing R/C cars.

Racing in Adrian is a family affair; everyone either helps, or, at the very least, watches. Often, family members compete against one another in the same class. It's always lots of fun; watching dad lose to his 10-year-old kid is great. (Of course, it's much less embarrassing when dad races in a different class.)

There has been a lot of discussion lately about cost-control racing. Although nobody refers to it by that name in Adrian, it is, in fact, the most popular type of racing. There are very few high-tech, expensive cars, but there are lots of low-tech cars that get foam tires in the winter and off-road tires in the summer. Dynos and commutator lathes are practically nonexistent. Several "fun" cars—designed for playing, not competing—also race. There are several really fast drivers who put on good shows (which is great, because they show everyone else what can be done with R/C cars once you get good at driving!). Those are the races that everyone crowds around to watch!

During the summer, races are run outdoors; but when fall comes, things move inside the Hope Center—a local community center. The Adrian club opens the doors to the Hope Center by noon. Sunday, January 22 was a typical race day. With the parking lot covered by 6 inches of snow, parking-lot racing took on new meaning; the emphasis was on who could get themselves and their equipment into the

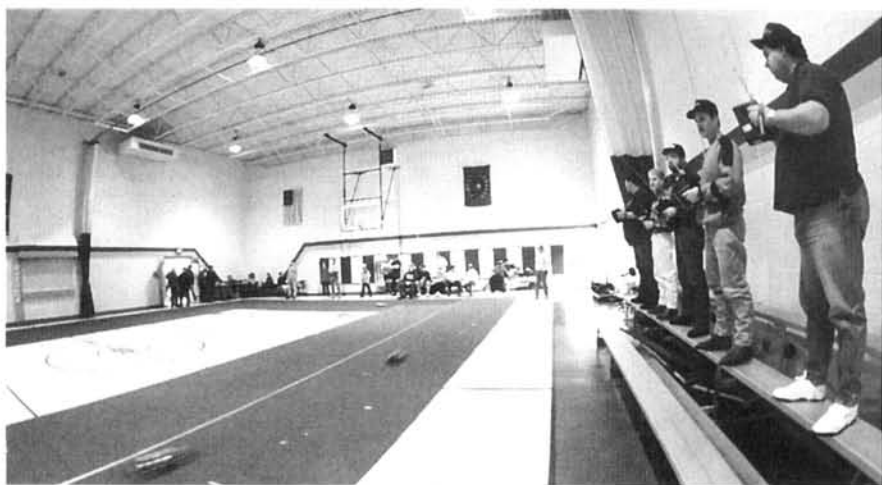
There has been a lot of discussion lately about cost-control racing. Although nobody refers to it by that name in Adrian, it is, in fact, the most popular type of racing.

warm indoors in the least time. Considering the weather, it was nice to see that 56 people came out to race.

The first project of the day is to bring out the carpet and lay down the track. Wherever there is carpet, it's considered part of the track. The indoor basketball court is quickly converted into a medium-size carpet oval. The track is made as large as possible, but plenty of room is left around the outside for pit tables and race marshals. The bleachers alongside the track are used as the drivers' stand.

The oval track has a 12-foot-wide lane, and it's 150 feet long around the center line's circumference. The club alternates between road-course and oval. Oval brings out the greatest number of racers, but those who try road-course usually find it a lot of fun—once they learn how to turn both ways. There are no boards (that means fewer broken cars), and the insides of the turns are marked by three dots. Drivers learn quickly that almost any other kind of mistake is preferable to hitting the dots; they're very unforgiving. Still, although hitting a dot usually results in a crash, the cars aren't going fast enough to really hurt anything other than the driver's pride.

The track is set up by 12:30 p.m. or so, at



Keeping Track on the Track

While practice is going on, the races are being organized on a large metal board that hangs on the wall. The board is divided into a grid, with 12 or so rows (one for each race) and 10 columns. Cars in the first column race as car number 1, cars in the second column race as car number 2, and so on. When a racer signs up, he fills out his name, frequency and class on a magnetic card, which is then placed on the large board under the appropriate class title. When racers come to check the board, they verify that their card has been placed in the correct race, and they determine their car's race number. Because the club doesn't yet have an AMB scoring system, it's up to each racer to put his number on his car's front windshield. Racers also check their frequency and that there aren't any frequency conflicts for that race. A frequency board by the drivers' stand has clips for all the legal frequencies, including the new odd-number channels. (If you're smart enough to get a radio with an odd frequency, you almost never have to wait for a frequency clip.) One of the few rules at the club is that you never turn on your radio without having a frequency clip.

which time, it's opened for practice; sign-in starts a little later. There are classes for pan cars, buggies and trucks, and all of those have separate classes for stock and modified. When there are enough cars, other classes are created; it takes only three cars to make up a class.

There are also beginners' classes. On this day, there were 14 beginners. Adrian is an

into 10 heats, race 1 is marshaled by the racers from race 10 and scored by the racers from race 9. Scoring is pretty easy; the club has an LC-1000 lap-counting system, to which six cables with push-buttons at their ends are attached. When the car you're monitoring goes past the finish line, you push the button, and that counts as a completed lap for the car. The LC-1000 keeps track of the time, who's in the lead, and so on, and it gives the race director the necessary information to keep the racers (and spectators) apprised of the racers' progress. Gary also informs the slower drivers when the lead car is about to lap them so they can move over to let it pass.

Everyone gets to run two qualifiers and a main event. The winners of each Main get a small plaque inscribed with their finishing positions, and they get a discount on the next week's racing. The club is also starting to hold trophy races (the first one for 1995 was in February).

The club once had the typical problem that everyone wanted to play, but no one wanted to work. This made things hard for the few individuals who stuck around to pick up the carpet when the races were over. I discussed this with Gary last year, and we came up with an idea that seems to be working well; race fees were raised by \$1 (to \$6 for club members, \$8 for non-members). With 56 racers at \$1 each, that's \$56 extra. This money is distributed to the club members who stick around to help put things away when the racing is over. Since we incorporated this system, there have been no problems getting enough members to help.

Racing in Adrian is lots of fun and doesn't have to be very expensive. Anyone who wants to start an R/C club can follow this example very easily. It works! ■

excellent place to learn how to race because the track is small enough for you to always see what your car is or isn't doing. Out on the track, practice is often rather hectic. That's because, not only are up to 15 people trying to drive at the same time, but they also have a wide range of abilities; some are just starting, and others have been racing for years. If you're patient, though, you can find periods of relative quiet.

A drivers' meeting is held before the first qualifier. Gary Patterson, the club president, tells the racers about any upcoming races and notifies them about any frequency conflicts. Gary also reminds racers that their cars will go through "tech" after the races have been completed, and that they must weigh at least the specified minimum for that class. He also reminds people to take it easy in the qualifiers and hints that those who don't (or can't) may find themselves back in the beginners' class. The racing starts at around 2 p.m., and there are 3 minutes between races.

Because the club doesn't have AMB's automated lap-counting system, it uses a "race, marshal, score" system. All racers get to race; then they marshal the next race; and then, in the following race, they score the car that has "their" number on it. If the races are divided

INDEX OF MANUFACTURERS

Airtronics, 11 Autry, Irvine, CA 92718; (714) 830-8769.

...and Design, 225 S. Whiting St., Ste. 210, Alexandria, VA 22304; (703) 370-0558.

Associated Electrics Inc., 3585 Cadillac Ave., Costa Mesa, CA 92626; (714) 850-9342; fax (714) 850-1744.

Astro Flight Inc., 13311 Beach Ave., Marina Del Rey, CA 90292; (310) 821-6242.

Bolink R/C Cars Inc., 420 Hosea Rd., Lawrenceville, GA 30245; (404) 963-0252; fax (404) 963-7334.

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Chris's Top Ten

TOP 10 COOLEST

Cost Control Racing



Bruce Lee

Luna (my dog!)



Hot
blood in
the cold
sea



427 Cobra



Miracle Gro



Jack



Motorcycles



Mystery Science Theater 3000

+2

Chrissie Hynde
A promise kept



Coffee in the morning



■ BMW 325i convertible
(yuppie-sheep mobile)

TOP 10 LAMEST

- Madonna
- Calvin Klein commercials
- Power Rangers
- Hats on backwards
- Ricki Lake
- Car phones
- Michael Bolton
- Not saying "Hello"
- Social smiles